MEDCO08

- CRUISE REPORT -

03 – 24 November 2008

CNR IAMC - Istituto per l'Ambiente Marino e Costiero – Oristano

CNR ISMAR – Istituto di Scienze Marine - La Spezia

Consiglio Nazionale delle Ricerche

Università di Firenze

Ente Nazionale Energia e Ambiente

Università di Messina

Istituto Nazionale di Geofisica e Vulcanologia

Università di Palermo

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Cruise details

NAME	*MedCO08*
DATE	*3 – 24 NOVEMBER 2008*
STUDY AREA	*WESTERN IONIAN SEA* *SICILY STRAIT* *ALGERIAN BASIN* *TYRRHENIAN SEA* *SARDINIA CHANNEL* *BONIFACIO MOUTH* *ALBORAN SEA* *GIBRALTAR STRAIT*
PROJECT RESPONSIBLE	*A. PERILLI - CNR-IAMC - ORISTANO*
HEAD OF THE CRUISE	*MIRENO BORGHINI, CNR-ISMAR*
CRUISE CHIEF SCIENTIST	*ALBERTO RIBOTTI CNR-IAMC*
PARTICIPANT INSTITUTES	*CNR – IAMC* *CNR – ISMAR* *INGV* *ENEA* *FIRENZE UNIVERSITY* *MESSINA UNIVERSITY* *PALERMO UNIVERSITY*
RESEARCH VESSEL	*URANIA*
HARBOUR OF DEPARTURE	*MESSINA*
HARBOUR OF ARRIVAL	*NAPOLI*

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1. Scientific objectives

In this report we present all preliminary results obtained during the oceanographic cruise named MedCO08, carried out from November 3rd to 24th 2008, on board the R/V URANIA in the central and western Mediterranean basins.

The cruise has been planned to reach the following objectives:

1. **Water masses characteristics and biological structures**

   Several measurements along key sections localised inside and on the board of the basin in order to define the main paths of the circulation and the physical-chemical-biological properties (temperature, salinity, dissolved oxygen, nutrients, chlorophyll, phytoplankton, primary production, etc) of the water upper, intermediate and deep central (western Ionian sea and Sicily Strait) and western (Tyrrhenian sea, Algerian basin, Alboran sea) Mediterranean water masses. Check of the diffusion of the new deep waters found during the cruise in 2005 in the same areas.

2. **Validation of numerical models**

   Measurements will be used to validate three numerical circulation models implemented at IAMC-CNR in Oristano (SCRM and WMRM) and at ISMAR-CNR in La Spezia (box model). The two models at IAMC-CNR in Oristano are then operational models as they give daily forecasts for the following 5 days of the main oceanographic parameters (temperature, salinity, water and surface heat fluxes, currents, waves).

3. **Methodological developments**

   - **Measurements of velocity profiles by Lowered ADCP;**
   - **Measurements of temperature profiles by XBT T5, T7 e DEEP-BLUE;**
   - **Periodical maintenance of currentmeters moored in the western Ionian sea and Corsica Channel;**
   - **Comparison of different methods for the quantification of Chlorophyll and calibration of the fluorometer coupled with the multiparametric probe through several photochemical techniques.**

2. State of the art

2.1 General description

The Mediterranean sea is a semi-enclosed sea at medium latitudes. Some fundamental processes for the general circulation of the oceans (ex. deep water formation) happen or are given by such sea. The salty waters in the Atlantic, exiting from the Mediterranean, cn influence the water formation processes, the variability and also the equilibrium state of the global thermohaline circulation, a mechanism by which large amounts of heat are exchanged inside and through the basins. The global thermohaline circulation has a fundamental role in contributing in the stabilization of the climatic system. The Mediterranean circulation, in the western basin, is forced by the wind stress, by the general floating forces generated by the heat and fresh water fluxes at the air-sea interface. The geography of the western Mediterranean is really complex with a really complex deep morphology and a distribution of its coasts, a variety of islands, straits, channels and openings. The exchanges through the different basins depend on the morphology of these straits, channels and openings. Due to a complex topography and geometry and of the high external forcing variability, the response time of the water masses and the spatial and temporal variability scales of the currents are really short than the oceanic ones. The recirculation time of the particles, inside the deep water formations areas, is around a hundreds years at Mediterranean scale, a really short climatic scale if compared with the Atlantic temporal scales of millenniums. The general view that grows up is that of a Mediterranean climatic system always interacting with the atmosphere that stores the information of the changes at the air-sea interface and modifies currents at the abyssal depths. This allows the Mediterranean, and then its western basin, to “react” really quickly to the changes of atmospheric forcing and then to be a “sensor” of the Earth climate. The study of the functioning of marine ecosystems and their response to external forcing is then controversial because really complex. The hydrological characteristics of the different water masses behave differently following depth and geographic position with different modifications in act. In the 30’s two different behaviours have been observed, a constant increase in temperature and salinity in the deep and intermediate levels of the western Mediterranean and a more complicated variability of the eastern basin, followed by the climatological transient. What is sure it is then the observation of a phenomenon in the yearly ‘90s that, due to its dimension and speed, is one of those events characterised by a strong discontinuity: the so called climatological transient. This transient shows as the collapse of a system apparently stable can happen suddenly. In a few years the vertical structure of the basin has been completely modified. The possible reasons of the climatological phenomenon in the eastern basin have been widely described in the specialised literature (Malanotte-Rizzoli et al., 1999; Demirov and Pinardi 2002, Rupolo et al, 2003). This anomaly begun to propagate in the western basin (Schroeder et al., 2006; Schroeder et al., 2007, Schroeder et al., 2008). Actually it is difficult to forecast the effects of such an anomaly in the western Mediterranean even if the long times of run of the intermediate waters in the western basin probably will contribute to absorb it decreasing its effects. Vice versa the occurrence of such a phenomenon has underlined once more as the balances of a complex system can be strongly modified also by small variabilities of one of its components.

The temporal analysis of the analysed data does not permits to understand if these oscillations are characteristics of a natural state of the basin or, viceversa, if they represent an anomalous situation.

The cruise is part of a strategy for the periodic monitoring of this new hydrodynamic regime in order to evaluate the hydrodynamic and biogeochemical characteristic trends of the waters along the column and their interannual variabilities. For this reason the cruises have been repeated every year. Furthermore the biogeochemical anomalies N/P and the difference between the variables north and south of the basin, with two different hydrodynamic regimes, have been analysed.

Then in the area two regional hydrodynamic numerical models are operative giving a 5-days forecast of the sea state of the central and western Mediterranean updated daily. These cruises are also organised in order to calibrate and validate the two circulation models at basin scale. Comparative studies with in-situ data, from satellite and models outputs will be used to evaluate the interannual variability of the dynamics at basin scale. Furthermore they will be used to study the mechanisms regulating and modulating the Chlorophyll distribution in mesoscale processes.

Finally this cruise has been realised in the Algerian basin because previous studies have shown like such an area represents a crucial region to under stand the exchanges between different Mediterranean sub-basins (Santinelli et al, 2006; Puillat et al., 2006; Ribotti et al., 2004, Schroder et al., 2006). The region s interested by two different hydrodynamic regimes mainly driven by the wind at north and from the mesoscale structures, mainly anticyclonic eddies for the instability of the Algerian current, at south playing a key role in the detachment of the LIW (Ribotti et al., 2004).

This cruise is strictly linked with the previous ones Medgoos (2000-2006), MedOc (2005-2006), MedBio (2006), MedCO07 (2007) and SESAME-IT4 (2008) where zonal trends of the hydrodynamic and biogeochemical characteristics of the water masses in the western basin.
The work has been done with CNR-ISMAR, INGV and ENEA in La Spezia to study the hydrodynamics and with the universities of Firenze and Messina for the biological aspect. The Department of Geology and Geodesy of Palermo University has done a core in the Alboran sea, repetition of the ODP site number 977 for the palaeo-climatological study starting from the last glacial.

2.1.1 Main hydrodynamic characteristics in the study areas

The **central Mediterranean** (Sardinia and Sicily channels) is characterised by a really complicated bottom topography directly influencing on the water exchanges between the two Mediterranean basins (eastern and western). In the Sardinia channel the threshold depth is about 1900 m. This allows the Exchange of deep waters in the western Mediterranean. The Sicily Strait is instead characterised by two strict passages with the deepest one about 430 m depth giving strong limits to the exchanges with the eastern Mediterranean. Over these two thresholds, a wide and shallow area far off Tunisia (Skerki bank) is another obstacle to a direct link between the water masses in the two basins.
Easterly of the Sicily Strait there is the **Ionian basin** where the upper current of Atlantic Water is here named Ionian-Atlantic current crossing the Ionian basin at a latitude of about 36° N then dividing the Ionian in two parts: in the northern we find the *Cyclonic Gyre of the western Ionian* while in the southern one or more anticyclonic gyres are present. Deeper, the intermediate water divides in a northern branch through the Otranto Strait and one to the center of the Ionian then moving to the Sicily Strait.
The **Tyrrhenian sea** is linked both with the western Mediterranean as the eastern and is an intermediate basin whose southern part is linked to the central Mediterranean through a shallow channel permitting the passage of the LIW (*Levantine Intermediate Water*) and of the tEMDW (*transitional Eastern Mediterranean Deep Water*) that, sinking at the entrance of the Tyrrhenian sea, .origins the TDW that will move over the WMDW. The Opening Sicily-Sardinia is mainly formed by two channels with a wide intermediate plain. The deepest, in its central part, directly links the Tyrrhenian sea to the Sardinia channel and to the rest of the western Mediterranean. All the water masses composing the water column from the surface to the bottom pass through it.

The **Algerian basin,** along the Algerian coast, is characterised by an abyssal plain over 2500 m deep and crossed by the AW (*Atlantic Water*) coming from the Gibraltar strait that mixes with the Mediterranean water originating the MAW (*Modified Atlantic Water*). Such a flux moves eastward (*Algerian Current)* along the north African coast with a meandering path due to the coastal morphology and whose closed meanders originate cyclonic and anticyclonic eddies (the latter named AEs – *Algerian Eddies*) with dimensions from 50 to 200 km in diameter and a “life” from a few days to some month. These eddies move eastward to the Sardinia Channel but, due to very shallow bathymetries, the deep eddies (until 1000 m) remain in the western basin circulating anticlockwise in the central-southern part of the Algerian-Provencal basin, while a large part of Atlantic water masses cross the Sicily Strait to the eastern basin.

Resuming, the study area is a very complex system with an almost sub-tropical climate. Furthermore in the central Mediterranean area is present the widest community of marine mammals and fishes of the whole Mediterranean basin.

Other interesting aspects regards the hydrological properties (temperature and salinity) of the deep and intermediate layers, that show a positive trend for some decades. The reasons of this trend are still unknown.

An increase of the knowledge of all these aspects will contribute to a better comprehension of the role and functioning of the Mediterranean sea.

3. Cruise plan

The following table shows all the measured parameters and the working groups involved in the operations. Table 2 lists the instrumentation and analysis methods used.

Parameters/Instruments	**Working Groups**
CTD/O2/rosette	CNR-ISMAR/ IAMC
XBT	CNR-ISMAR/ IAMC / ENEA
Dissolved oxygen	CNR-ISMAR
NO3, P04, SiO4	Firenze University
Chlorophyll	Firenze University
Fitoplankton	Firenze University
Measures of optical properties	Firenze University
Marine midrobic microbiology	Messina University
Coring	Palermo University
Salinity	INGV
Metals	INGV
Radioactivity	INGV

Table 1 Measured parameters

Small sampling volume	Rosette General Oceanics 24-bottles of 10 l
CTD System	CTD SBE 911 plus
XBT	T4 & Deep Blue (LM Sippican Inc.)
Oxygen	Winkler titration
Nutrients	Only samplings, no analyses on board
Chlorophylls and carotenoids	Sampling and filtration
Phytoplankton	Sampling
Measures of optical properties	Sampling and filtration
Underwater spectral irradiance	Spettroradiometer LI-COR LI-1800UW
Underwater irradiance	Photobathisonde Idronaut
Natural fluorescence, PAR, UV-A e B	PUV Biospherical 510B
Absorption, attenuation of light in the water field	Spectral-photometer AC90193

Table 2 Instrumentation for the sampling and analysis methods

The geographical limits of the study area are 35.00°N - 42.00°N of latitude and 7°W – 16°E of longitude. Due to bad sea conditions, the expected sampling plan has been partially reorganised, particularly in the area between Balears and Sardinia (see pictures).

4. Cruise maps

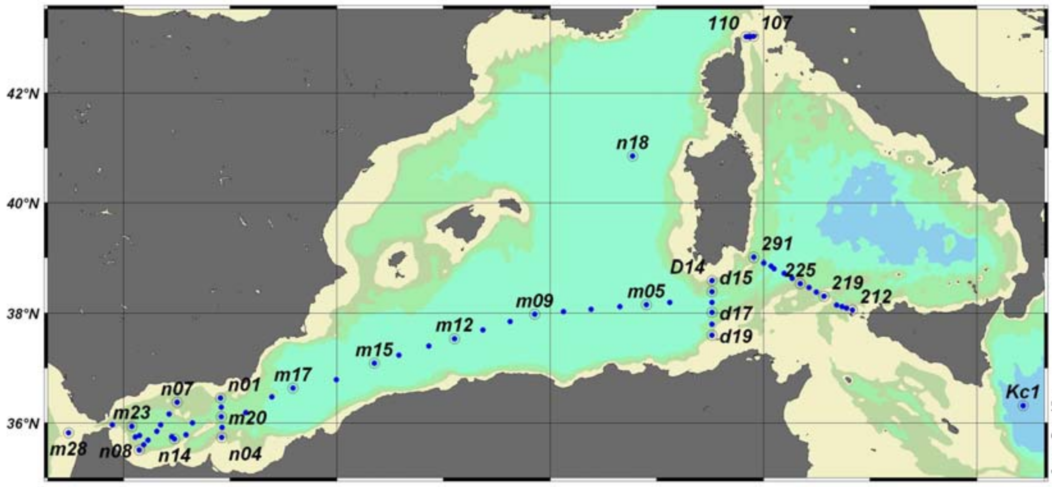
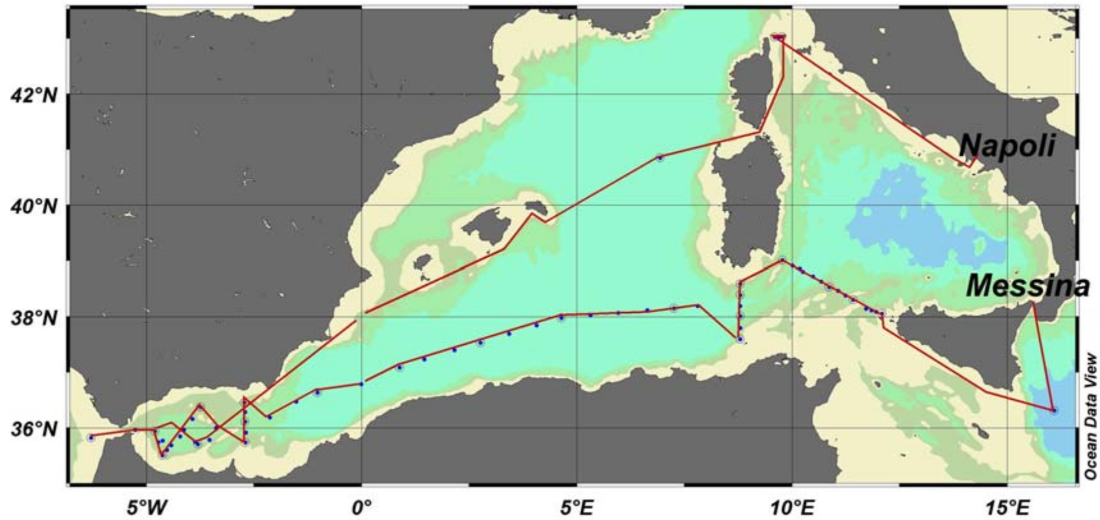


Figure 4.1 Maps of the CTD casts (up) and of the cruise path (down)



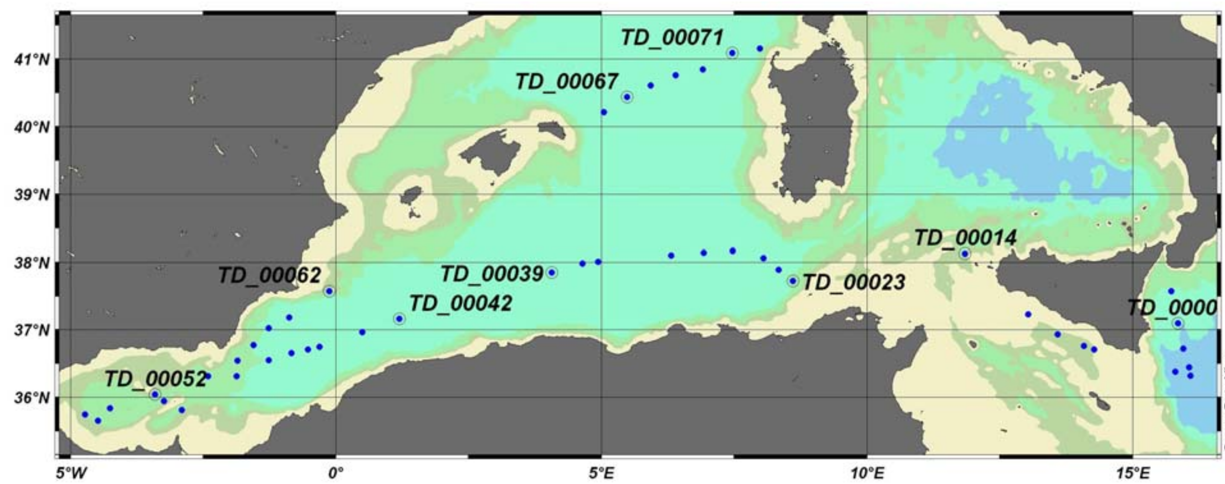


Figure 4.2 Map of the sampled XBTs

Table 4.1 CTD casts list

Sampling type and institute: N = Nutrients (CNR); C = Chlorophyll α (Firenze Univ); F = phiytoplankton (Firenze Univ); Ot = optical properties (Firenze Univ); O = dissolved oxygen (CNR); E = marine microbic ecology (Messina Univ).

#	Station	Date (dd.mm.yy)	Time (GMT+1)	Lat N (° ‘)	Lon (° ‘)	Depth (m)	Sampling type
1	KC1	04.11.08	06.45	36° 18.098	016° 05.464E	3365	E–N–C–F–Ot
2	212	05.11.08	13.56	38° 03.125	012° 05.647E	135	E–C–F
3	213	05.11.08	15.03	38° 05.223	011° 57.427E	409	
4	214	05.11.08	16.19	38° 07.198	011° 50.848E	1122	E– C
5	216	05.11.08	18.05	38° 08.898	011° 43.032E	959	N
6	219	05.11.08	20.51	38° 18.522	011° 25.542E	845	E– C
7	221	05.11.08	22.38	38° 23.042	011° 14.765E	695	
8	223	06.11.08	00.13	38° 28.015	011° 04.605E	841	C
9	225	06.11.08	06.47	38° 31.988	010° 52.056E	735	
10	227	06.11.08	08:29	38° 37.938	010° 40.976E	1528	E–N–C–F–Ot
11	229	06.11.08	12.40	38° 43.295	010° 29.621E	2468	E–N–C–F–Ot
12	229S	06.11.08	15.00	38° 43.306	010° 28.946E	55	
13	231	06.11.08	16.44	38° 48.280	010° 15.441E	2313	C–F
14	241	06.11.08	19.11	38° 51.350	010° 11.021E	2533	E
15	261	06.11.08	22.37	38° 54.819	010° 00.932E	1474	
16	291	07.11.08	01.00	39° 00.481	009° 46.957E	1022	
17	D14	07.11.08	10.01	38° 35.621	008° 35.620E	703	C–F–Ot
18	D15	07.11.08	12.25	38° 23.596	008° 48.049E	1400	E–N
19	D15B	07.11.08	14.45	38° 23.620	008° 48.121E	1000/1400	
20	D16	07.11.08	17.02	38° 11.520	008° 48.012E	2252	N–C
21	D17	07.11.08	19.49	38° 00.593	008° 48.051E	1604	C
22	D18	07.11.08	22.06	37° 47.897	008° 48.002E	1404	
23	D19	08.11.08	00.17	37° 35.874	008° 48.014E	492	C–F–Ot
24	M4	08.11.08	07.15	38° 11.903	007° 48.831E	2799	E–N–C–F–Ot
25	M5	08.11.08	12.38	38° 09.146	007° 15.659E	2847	E–C–F–Ot
26	M5B	08.11.08	14.46	38° 09.196	007°15.667E	25	
27	M6	08.11.08	17.57	38° 06.937	006° 38.184E	2853	N–C–F
28	M7	08.11.08	22.45	38° 04.196	005° 58.079E	2848	E
29	M8	09.11.08	03.30	38° 01.752	005° 19.326E	2840	N
30	M9	09.11.08	08.37	37°.58.703	004°.38.834E	2799	E–C–F–Ot
31	M9S	09.11.08	11.02	37°58.943	004°39.099E	2800	
32	M10	09.11.08	14.08	37°50.889	004°04.184E	2801	
33	M11	09.11.08	19.01	37°41.481	003°25.684E	2818	C
34	M12	09.11.08	23.52	37°32.138	002°46.133E	2812	
35	M13	09.11.08	04.25	37°24.199	002°09.527E	2792	N
36	M14	10.11.08	09.55	37°13.995	001°27.820E	2778	E–C–F–Ot
37	M15	10.11.08	15.38	37°05.329	000°53.214E	2751	N
38	M16	10.11.08	21.49	36°47.300	000°00.148W	2693	C–F
39	M17	11.11.08	04.26	36°37.905	001°01.415W	2649	E–N–C–F–Ot
40	M18	11.11.08	08.43	36°28.541	001°30.893W	2302	C–F
41	M19	11.11.08	14.25	36°11.353	002°07.537W	1945	E–N–C–F–Ot
42	N1	11.11.08	19.22	36°27.278	002°43.110W	948	E–C
43	N2	11.11.08	21.02	36°17.016	002°42.058W	1742	
44	M20	11.11.08	23.09	36°06.673	002°42.133W	1834	E–C
45	N3	12.11.08	01.31	35°55.043	002°41.036W	1134	
46	N4	12.11.08	03.25	35°43.958	002°41.683W	399	E–C
47	M21B	12.11.08	07.52	36°00.085	003°22.510W	1699	E–C
48	N7	12.11.08	12.38	36°22.426	003°44.065W	915	E–C–F–Ot
49	N5	12.11.08	15.35	36°09.692	003°55.407W	1183	

50	M22B	12.11.08	21.22	35°50.764	004°12.877W	1260	
51	N6	13.11.08	00.07	35°41.183	004°25.232W	1458	
52	N9	13.11.08	01.58	35°35.988	004°31.186W	1054	N
53	N8	13.11.08	03.50	35°.30.440	004°37.616W	499	
54	M22	13.11.08	08.26	35°57.959	004°07.322W	1383	N
55	N10	13.11.08	13.17	35°46.418	004°37.162W	1268	E
56	N11	13.11.08	14.47	35°44.640	004°43.147W	965	
57	M23	13.11.08	16.40	35°56.404	004°48.121W	1032	E–C
58	M24	13.11.08	19.41	35°58.063	005°15.422W	656	E
59	M28	14.11.08	03.05	35°49.004	006°16.870W	411	E
60	N13	14.11.08	16.00	35°44.870	003°51.677W	1415	
61	N14	14.11.08	17.00	35°42.274	003°47.752W	1390	
62	N15	14.11.08	20.40	35°47.166	003°31.781W	1077	
63	N18	18.11.08	22.53	40°50.893	006°56.287E	2819	
64	108	20.11.08	09.57	43°01.459	009°42.058E	445	C–F
65	109	20.11.08	10.56	43°01.515	009°38.546E	366	C–F–Ot
66	110	20.11.08	11.49	43°01.476	009°35.994E	243	C–F
67	108bis	20.11.08	13.54	43°01.493	009°42.005E	440/200	
68	107	20.11.08	14.28	43°01.698	009°46.004E	87	C–F–Ot

Table 4.2 XBT stations list

Note: v = ship velocity at launching time; W = wind velocity at launching time

Number	Type	Date	Time(UTC)	Latitude	Longitude	Comments
1	DB	20081103	22 15	37° 34.1'N	015° 43.8'E	
2	DB	20081104	01 11	37° 05.8'N	015° 51.3'E	
3	DB	20081104	03 28	36° 43.1'N	015° 57.7'E	
4	DB	20081104	05 33	36° 26.7'N	016° 04.1'E	
5	DB	20081104	07 15	36° 19.0'N	016° 05.5'E	TEST
6	T4	20081104	07 35	36° 19.0'N	016° 05.5'E	TEST
7	DB	20081104	13 16	36° 22.8'N	015° 48.4'E	
8	T4	20081104	21 40	36° 42.3'N	014° 17.0'E	
9	DB	20081104	22 43	36° 46.7'N	014° 05.3'E	
10	T4	20081105	01 17	36° 55.8'N	013° 35.4'E	
11	T4	20081105	04 26	37° 12.4'N	013° 02.3'E	
12	T4	20081105	16 24	38° 07.2'N	011° 50.8'E	TEST
13	T4	20081105	16 28	38° 07.2'N	011° 50.8'E	TEST
14	DB	20081105	16 34	38° 07.2'N	011° 50.8'E	TEST
15	DB	20081105	16 41	38° 07.2'N	011° 50.8'E	TEST
16	DB	20081106	16 46	38° 48.3'N	010° 15.4'E	TEST
17	DB	20081106	16 52	38° 48.3'N	010° 15.4'E	TEST
18	DB	20081106	16 59	38° 48.3'N	010° 15.4'E	TEST
19	T4	20081107	12 33	38° 23.6'N	008° 48.0'E	TEST
20	T4	20081107	12 39	38° 23.6'N	008° 48.0'E	TEST
21	T4	20081107	12 44	38° 23.6'N	008° 48.0'E	TEST
22	DB	20081108	01 49	37° 43.3'N	008° 36.4'E	
23	DB	20081108	03 33	37° 53.0'N	008° 20.2'E	
24	DB	20081108	05 26	38° 03.5'N	008° 03.3'E	
25	DB	20081108	10 35	38° 09.6'N	007° 28.6'E	
26	DB	20081108	16 27	38° 08.3'N	006° 55.8'E	
27	DB	20081108	21 05	38° 05.6'N	006° 18.7'E	
28	DB	20081109	07 10	38° 00.1'N	004° 56.3'E	
29	DB	20081109	08 39	37° 58.7'N	004° 38.8'E	TEST
30	DB	20081109	08 44	37° 58.7'N	004° 38.8'E	TEST
31	DB	20081109	08 48	37° 58.7'N	004° 38.7'E	TEST
32	DB	20081109	08 56	37° 58.7'N	004° 38.8'E	TEST
33	DB	20081109	09 07	37° 58.7'N	004° 38.8'E	TEST
34	DB	20081109	09 14	37° 58.7'N	004° 38.8'E	TEST
35	DB	20081109	14 10	37° 50.9'N	004° 04.2'E	TEST
36	DB	20081109	14 16	37° 50.8'N	004° 04.2'E	TEST
37	DB	20081109	14 26	37° 50.9'N	004° 04.2'E	TEST
38	DB	20081109	14 38	37° 50.8'N	004° 04.2'E	TEST
39	DB	20081109	14 43	37° 50.8'N	004° 04.2'E	TEST
40	DB	20081109	14 48	37° 50.8'N	004° 04.2'E	TEST
41	DB	20081110	13 56	37° 09.6'N	001° 12.0'E	
42	DB	20081110	19 08	36° 57.9'N	000° 30.1'E	
43	DB	20081111	00 49	36° 44.6'N	000° 18.2'W	
44	DB	20081111	01 51	36° 42.4'N	000° 31.2'W	
45	DB	20081111	03 18	36° 39.2'N	000° 49.9'W	
46	DB	20081111	07 16	36° 33.0'N	001° 15.6'W	
47	DB	20081111	12 06	36° 18.8'N	001° 52.0'W	

48	DB	20081111	17 16	36° 18.9'N	002° 24.1'W	
49	DB	20081112	04 57	35° 48.8'N	002° 53.9'W	
50	DB	20081112	06 51	35° 56.7'N	003° 13.9'W	
51	DB	20081112	09 08	36° 02.6'N	003° 24.1'W	
52	DB	20081113	05 34	35° 39.3'N	004° 28.4'W	
53	DB	20081113	07 14	35° 50.1'N	004° 15.1'W	
54	DB	20081113	14 48	35° 44.6'N	004° 43.6'W	TEST
55	DB	20081114	16 09	35° 44.8'N	003° 51.6'W	TEST
56	DB	20081115	06 18	36° 32.7'N	001° 51.1'W	
57	DB	20081115	08 13	36° 46.4'N	001° 32.9'W	
58	DB	20081115	10 17	37° 01.2'N	001° 15.6'W	
59	DB	20081115	12 29	37° 10.9'N	000° 52.6'W	
60	DB	20081115	14 48	37° 22.8'N	000° 29.3'W	
61	DB	20081115	16 54	37° 34.3'N	000° 07.2'W	
62	DB	20081118	12 55	40° 12.8'N	005° 02.7'E	
63	DB	20081118	15 26	40° 26.1'N	005° 28.9'E	
64	DB	20081118	17 46	40° 36.5'N	005° 55.9'E	
65	DB	20081118	20 10	40° 45.4'N	006° 23.9'E	
66	DB	20081118	22 36	40° 50.4'N	006° 54.7'E	
67	DB	20081119	03 12	41° 05.0'N	007° 27.9'E	
68	DB	20081119	05 31	41° 08.9'N	007° 58.9'E	

5. On board operations

5.1 CTD casts

At all the 68 hydrological stations, pressure (P), salinity (S), potential temperature (θ) and dissolved oxygen concentration (DO) were measured with a CTD-rosette system consisting of a CTD SBE 911 plus, and a General Oceanics rosette with 24 12-l Niskin Bottles. Temperature measurements were performed with a SBE-3/F thermometer, with a resolution of 10^{-3} °C, and conductivity measurements were performed with a SBE-4 sensor, with a resolution of 3 x 10^{-4} S/m. In addition, dissolved oxygen was measured with a SBE-13 sensor (resolution 4.3 µM), and data were checked against Winkler titration. The vertical profiles of all parameters were obtained by sampling the signals at 24 Hz, with the CTD/rosette going down at a speed of 1 m/s. The data were processed on board, and the coarse errors were corrected.

Laboratory: ISMAR-CNR, IAMC-CNR

5.2 XBT

During MEDCO08 cruise, 68 XBT probes have been dropped. The main aims were both the control of seawater temperature during the travel among different CTD stations, where also bio-measurements have been done and mooring recover and positioning, and the check of quality and accuracy of temperature profiles as recorded by XBT probes, through a comparison with contemporaneous and collocated CTD casts.

The used apparatus consists of:

- XBT probes, T4 and DB, manufactured by LM Sippican (USA);
- Hand launcher LM Sippican, model LM3A, with 50m long connection cable and MK21 connection box;
- Recording device LM Sippican MK 21 USB;
- Laptop (under Windows XP-Pro, SP-less)
- Plastic pipe, 2m long.

Sixteen-eight XBT probes have been dropped, in detail:

- T4 = nr. 9 (6 for comparison test);
- DB = nr. 59 (20 for comparison test).

Before the drop, each probe has been thermalised for few minutes in a bucket filled with fresh seawater aiming the reduction of thermal difference between the probe and seawater.

The height of the launching position for probes dropped when the ship was moving is 2.5m over the sea level, whereas it has been sometimes changed during test activity.

The real launching position has been varied depending on wind and wave conditions.

No malfunctioning has been observed with the exception of a problem with the connection cable, just travelling from Alboran Sea and Balearic Islands, due to a false contact forbidding the start of the acquisition.

Because of bad weather conditions, the XBT launching activity has been strongly reduced during the transect between Balearic Islands and Sardinia, and stopped after the positioning of the mooring near Capraia Island, because of strong winds and transversal waves as high as about 4m. Consequently, the real transect has been shifted near coastal region, in very shallow waters.

XBT test

Following the discussion during "XBT fall rate Workshop" (Miami-(USA), March 2008), a comparison test among profiles recorded with different XBT types and corresponding CTD cast has been scheduled in Mediterranean waters during MEDCO08 cruise.

More precisely, the profiles of XBT T4 and DB probes manufactured by LM Sippican and dropped from stationary platform within few minutes from the start of a CTD cast done by using a SBE 911plus system have been compared.

The temperature profiles are the output of a MK21 USB device, so that also the intrinsic accuracy of such an instrument influences the global accuracy of the recorded profiles.

XBT probes have been launched either as single drop test or within multiple sequential drops during the same CTD cast.

The height of the launching position was 2.5m over the sea level, with the exception of 6 DB probes, dropped from a platform 8.0m high.

XBT probes have been launched in correspondence with the following CTD casts (in parenthesis the number of drops): KC1(2), 214(4), 231(3), D15(3), M09(6), M10(6), N11(1) and N13(1). In each profile, the upper thermocline, usually at depth varying from 40 and 70 m, can be used as evident reference point.

DB probes have been manufactured in recent years (2007 and 2008), whereas T4 probes have been manufactured in 1993 and 1995, before the factory translation from USA to Mexico, and the change in the composition of the enamel used in the coating process. In addition, T4 were well "aged", well beyond the limit suggested by LM Sippican (some years).

Anyway, the wire remaining in the spool on the ship will be analysed, namely its linear density, aiming the identification of differences influencing the mass decreasing rate and, therefore, the value of the B coefficient in the XBT fall rate equation.

Fortunately, weather conditions during tests were good, windless and with small wave.
The profiles showing the temperature differences between XBT and CTD profiles will be accurately analysed also searching for the depth differences between corresponding thermal structures in order to better evaluate the probe motion. Fall rate coefficients well reproducing the motion of these probes will be computed and compared with values calculated from profiles recorded in 2003 and 2004. As a final step, remaining thermal bias and the global accuracy in XBT measurements will be estimated.
After a short and very preliminary analysis, the accuracy (namely, temperature and depth differences) is in a good agreement with values quoted by manufacturer.
Laboratorio: ENEA

5.3 Nutrients

Seawater samples for nutrient measurements were collected at different depths, when the system CTD /rosette was going up, according to the vertical profiles of salinity, potential temperature and dissolved oxygen, recorded in real time. Samples of 100 ml of seawater were collected at different depths and immediately filtered through a polycarbonate filter (0.47 μm Ø and pore size 0.4 μm) under slight vacuum. The filtered samples were transferred in 20 ml polyethylene vials and frozen at -20°C. The analysis of inorganic nutrients will be performed in the laboratory on land by the AutoAnalyser AAIII Bran+Luebbe (Grasshoff,1999).

- Not filtered and immediately frozen at -20°C (*ISMAR-CNR*);
- Filtered and fixed with $HgCl_2$ (*Firenze University*)

Concentrations of nitrates, orthosilicates and orthophosphates have been then determined in laboratory using an hybrid Brän–Luebbe AutoAnalyzer following the classical methods (Grasshoff et al., 1983) with only a few changes.
Laboratory: ISMAR-CNR and and Firenze University

5.4 LADCP

Two Lowered Acustic Doppler Current Profilers (LADCP) were used to measure velocity profiles. We used two RDI Workhorse 300 kHz ADCP. For data post-processing we used the LDEO LADCP (versione 8.1) software.
Laboratory: CNR-ISMAR

5.5 Measurements with photoprobe Idronaut and spectral-radiometer LI-COR LI-1800UW

Measurements and seawater samplings have been done to study relationships between apparent and inherent optical properties of the Mediterranean sea waters and the different taxonomical composition of the phytoplankton assemblages.
A spectro-radiometer LI-COR LI-1800UW has been used to measure the spectral downward irradiance and to compute optical properties as the spectral attenuation coefficient (Kd) and the spectral reflectance. Spectral downward irradiance (350-750 nm, resolution 1 nm) have been measured at 5, 10, 25, 50 and 75 m. A measure of upward irradiance has been done only at 5 m to compute the spectral reflectance in the field. Two measurements of spectral surface irradiance have been done. For technical reasons photoprobe idronaut that measures the vertical profiles of downward, upward and scalar irradiance, cannot be used.

Laboratorio: Università di Firenze

5.6 Measurements with AC-9 AC90193

Spectro-photometer ac-9 (Wetlabs) has been used to measure at the same time absorption ($a(\lambda)$) and attenuation ($c(\lambda)$) coefficients of a seawater sample. It is equipped by 2 cylindrical and parallel flow tubes that allow to measure simultaneously $a(\lambda)$ and $c(\lambda)$ coefficients at different wavelenghts (412, 440, 488, 510, 555, 630, 650, 676 and 715 nm) on water samples of different depth. $a(\lambda)$ and $c(\lambda)$ coefficients have been measured before and after two filtration on GF/F filter (Ø 47 mm, Whatman) and then on PC filter (Ø 47 mm, porosity 0.22 µm, Nucleopore). Particulate absorption and attenuation coefficients have been computed subtracting the filtered sample to the total one. The mathematical subtraction of the absorption coefficient from the attenuation one will allow to obtain the scattering coefficient($b(\lambda)$) of the water samples.

Laboratorio: Università di Firenze

5.7 Measurement of bio-optical parameters using the PUV Biospherical 510B profiler

Measurements of PAR (Photosynthetic Active Radiation), UV-A (380 nm) and UV-B (305 nm), and natural fluorescence of chlorophyll a have been done by means of a PUV Biospherical 510B profiler. The probe is equipped by 2 optical sensors which measure PAR, UV-A and B at the sea surface and underwater until 80 m, respectively. Besides it is equipped with temperature, pressure and natural fluorescence sensors. The software allows to compute other parameters as the vertical attenuation coefficient (Kd), Chlorophyll a concentration, and the primary production. The vertical profile of PAR can be used to determine the depth of the euphotic zone (1% of the surface sunlight).

Laboratorio: UNIFI

5.8 Turtles and other cetaceans sightings

A table to be filled by the ship crew with all sightings of turtles and other cetaceans (dolphins, wales, etc.) has been left on the bridge of the ship. In the following table type of sighting, date, time and number of animals are resumed.

date (dd/mm/yyyy) time (GMT+1)				
	latitude	37° 58,7 N	**Turtle**	n° 1
09/11/2008	**longitude**	004° 38,8 E	**Wale**	n° /
10.45			**Dolphin**	n° /
	latitude	37° 45,94 N	**Turtle**	n°1
09/11/2008	**longitude**	003° 43,76 E	**Wale**	n°/
18.20			**Dolphin**	n°/
	latitude	36° 24,15 N	**Turtle**	n°/
11/11/2008	**longitude**	001° 39,04 E	**Wale**	n°/
11.50			**Globicephala**	n° 4/5
	latitude	36° 14,61 N	**Turtle**	n°/
11/11/2008	**longitude**	002° 01,58 W	**Wale**	n°/
12.59			**Stenelle**	n° 10
	latitude	36° 11,92 N	**Turtle**	n° 1
11/11/2008	**longitude**	002° 06,37 W	**Wale**	n°/

13.30			**Dolphin**	n°/
	latitude	36° 16,95 N	**Turtle**	n°/
12/11/2008	**longitude**	003° 37,50 W	**Wale**	n°/
12.00			**Stenelle**	n° 4
	latitude	36° 22,53 N	**Turtle**	n°/
12/11/2008	**longitude**	003° 43,84 W	**Wale**	n°/
12.30			**Globicephala**	n° 5/6
	latitude	35° 51,73 N	**Turtle**	n°/
13/11/2008	**longitude**	004° 21,90 W	**Wale**	n°/
10.40			**Stenella**	n° 1
	latitude	35° 52,90 N	**Turtle**	n°/
13/11/2008	**longitude**	004° 46,30 W	**Wale**	n°/
16.05			**Dolphin**	n° 6
	latitude	35° 57,90 N	**Turtle**	n°/
14/11/2008	**longitude**	005° 22,50 W	**Wale**	n°/
7.00			**Dolphin**	n° 10
	latitude	36° 56,761 N	**Turtle**	n° 1
15/11/2008	**longitude**	001° 20,791 W	**Wale**	n°/
9.40			**Dolphin**	n° /
	latitude	36° 53,673 N	**Turtle**	n° 1
15/11/2008	**longitude**	001° 24,380 W	**Wale**	n°/
10.14			**Dolphin**	n°/

Laboratory: CNR-IAMC

5.9 GEMS

The activity was focused on GEMS (Gamma Energy Marine Spectrometer, figure below) deployment on a mooring site offshore Cape Passero in the framework of the KM3NET European project. It regards studies about shore and deep sea infrastructure and evaluation

GEMS mounted in mooring cage, with its power supply

of candidate sites, in order to assess oceanographic, biological and geological data from candidate sites, particularly INGV acts on seismic and oceanographic data processing from

SN-1 for Cape Passero areas, and on the evaluation of needs of further measurements (in collaboration with INFN-CNR); to perform missing measurements, in radioactivity monitoring by innovative sensor and multi-parametric analyses (by casts and/or mooring).

Although the sensor is specifically addressed to the objectives of the European KM3NET Project, its availability for other scientific and environmental applications is of enormous importance, such as for monitoring natural radioactivity in correspondence with submarine fluid seepage sites or man-made radioactivity in contaminated areas (e.g., nuclear submarine leakages, nuclear waste disposal, river discharges, coastal monitoring). More generally, underwater radioactivity is a key topic of environmental security; new monitoring tools for direct and on-site detection are highly desirable, as outlined by the IAEA (International Atomic Energy Agency). Prototype of radioactivity sensor (radiometer) for underwater measurement shall be developed. The sensor shall be particularly sensitive to gamma detection of 40K but suitable to detect also other natural (e.g., U, Th) and man caused radionuclides (e.g. 137Cs, etc.) occurring in the ocean seawater.

Specifically, the sensor shall be able to detect:

-standard activity in ocean seawater of 40K (10 Bg/kg), 238U (0.04 Bq/kg), 232Th (4x10-7 Bqkg), and their variations of about 10%;

- activity of 137Cs (sensitivity equal or better than 0.03 Bq·s–1±10% for point source located at 12 cm distance on the detector axis);

-statistical uncertainty (confidence probability P = 0.95) shall not bet more than 25%.

Laboratory: INGV

5.10 Marine midrobic microbiology

10 stations, at 7 depths (bottom, 2000 m, 1500m, 1000 m, 700 m, 100 m and surface), have been filtered with different sea water volumes to study microbial biodiversity using CARD-FISH technique. Then the sea water samples from Niskin bottles have been processed on board to perform viable counts and isolation of Heterotrophic Bacteria on Marine Agar medium (MA) and Luminescent Bacteria on SWC (Sea Water Complete) medium (Figure 5.10.1.). They will be characterized in laboratory using morpho-physiological and tassonomic approaches.

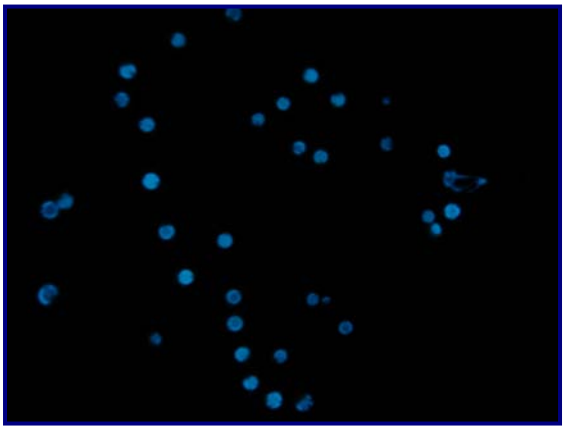


Figure 5.10.1.Luminous Bacteria Strains

Some samples are filtered on Millipore filters 0,22 µm and stored in "RNAlater" for a taxonomic study by molecular approach. As a consequence, DNA-RNA extraction was carried out to compare active and inactive microbial communities, coming from different water masses. Filters are stored at -20 °C after incubation in "RNAlater" storage solution.

Laboratory: Messina University

5.11 Other operations on board

DATASONIC DSP-661 Chirp 2 Profiler 4SBP at 3.5 kHz, with positions recorded on the XTF trace headers as lat/long of the DGPS antenna

Laboratory: CNR-IAMC & CNR-ISMAR

RESON Seabat 8160 (50 kHz, 3X, 126 beams at 0.5° covering at 150° installed on the keel through bulb protruding of about 1.5m)

Laboratory: CNR-IAMC & CNR-ISMAR

Ship mounted ADCP (SADCP)

Laboratory: CNR-ISMAR

Recovering and maintenance of moorings

Laboratory: CNR-ISMAR

Chlorophylls and carotenoids

Laboratory: Firenze University

Phytoplankton

Laboratory: Firenze University

CDOM (yellow substance)

Laboratory: Firenze University

Suspanded particulate

Laboratory: Firenze University

Phytoplankton and Detritus absorption and backscattering spectra

Laboratory: Firenze University

6. Preliminary Results

6.1 Meteo-marine conditions and problems on board

The meteo-marine conditions during the cruise have been characterised by a strong variability but, usually, by a medium-high atmospheric pressure in the first two weeks and very low pressure during the last. This has permitted to do all planned activities, with only 4 days of inactivity and the transect between Balears and Sardinia delayed (only one station was done during the transfer in the Bonifacio Mouth). The rough sea in the first days of the cruise has determined indisposition in some researchers on board for some days.

Some technical problems occurred during the cruise related to the closure of the bottles on the rosette during the measurements. This obliged to a repetition of the same cast several times with time and, possible, data lost.

6.2 Hydrology

In the following pages the preliminary graphic results of hydrological data are presented.

The analysis will be done separately for each studied areas (western Ionian sea, Sicily strait, Sardinia channel, etc.).

6.2.1 Western Ionian sea

In Figure 6.2.1.1 the XBT launches done during the path from Messina to the first hydrological station KC1.

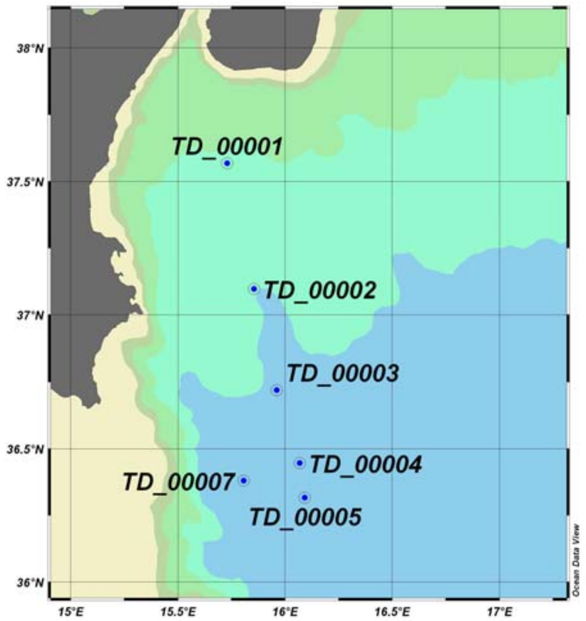


Figure 6.2.1.1. The 6 XBT stations from Messina to the CTD station KC1 in the western Ionian sea

In the following figure a section with the temperature measured by 5 XBTs along the eastern Sicilian shelf is shown.

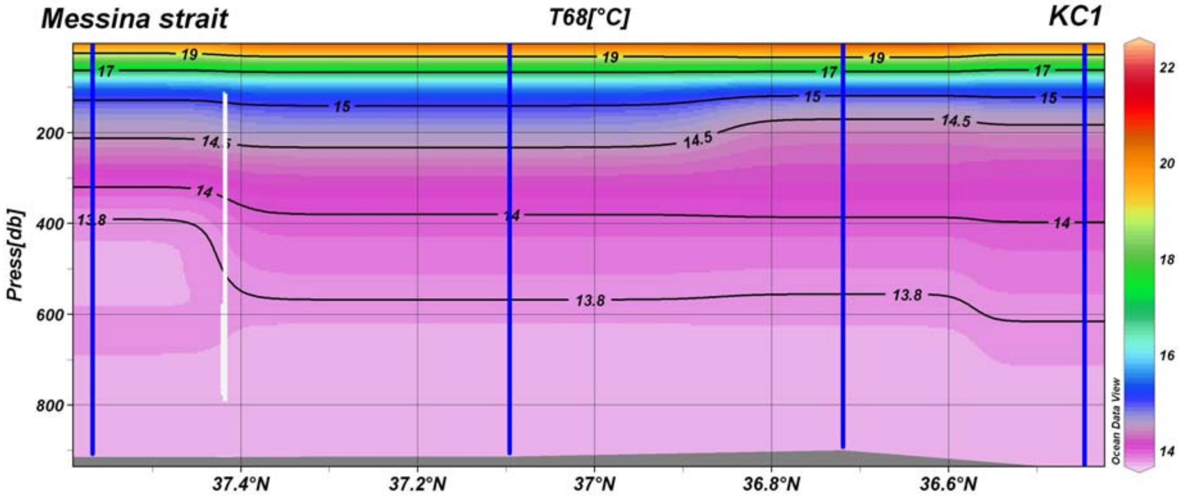


Figure 6.2.1.2. The section obtained with the temperature data from the XBTs along the eastern Sicilian shelf.

In Figure 6.2.1.3 the station KC1 in visible while its coordinates are in table 4.1.

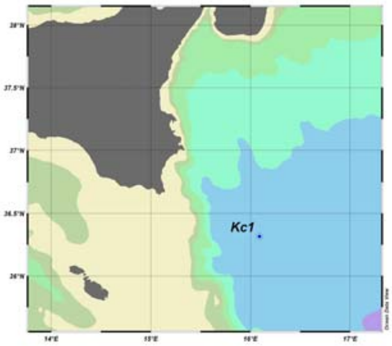


Figure 6.2.1.3. The station KC1 in the western Ionian sea where the mooring has also been deployed.

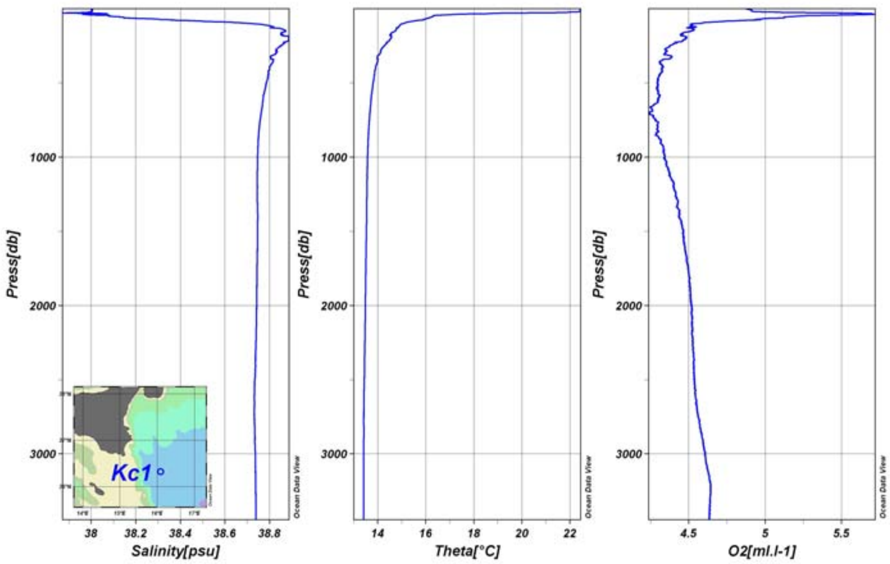


Figure 6.2.1.4. Temperature (center), salinity (left) and dissolved oxygen (right) profiles at the station KC1

The station has been done where, successively, a mooring (see Figure 6.2.1.X and the following description) has been deployed in the frame work of the European project KM3.
The profiles of salinity, temperature and dissolved oxygen are shown in Figure 6.2.1.4 left, center and right, respectively. A description of the mooring follows in the paragraph 6.3.1.
Data has been used to validate the Sicily Channel Regional Model, developed at IAMC-CNR in Oristano, for its eastern boundary (western Ionian sea) and the Sicily strait. This part in the framework of the national project PRIMI and the European project ECOOP.
Here below a picture (Figure 6.2.1.5.) of the profiles until 200 m of the model temperature near the four XBTs in the Sicily strait.

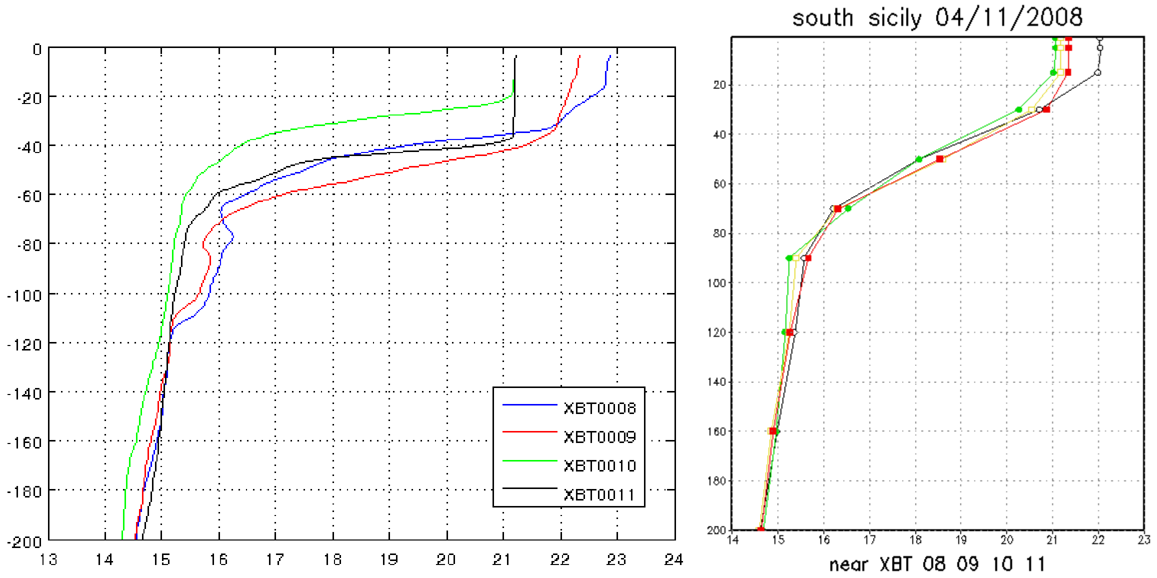


Figure 6.2.1.5. XBTs (left) and model (right) temperature profiles in the Sicily strait on Nov 4th, 2008

The two pictures show that the model well approximate the real profile showing only a small difference at the surface where the model gives a warmer temperature.

6.2.2 Central Mediterranean sea

In Figure 6.2.2.1 the two transects between Sardinia and Sicily and between Sardinia and Tunisia are visible.
The importance of these three transects is given by their central position in the whole Mediterranean basin and obliged passage for the waters coming from west to east and vice versa.

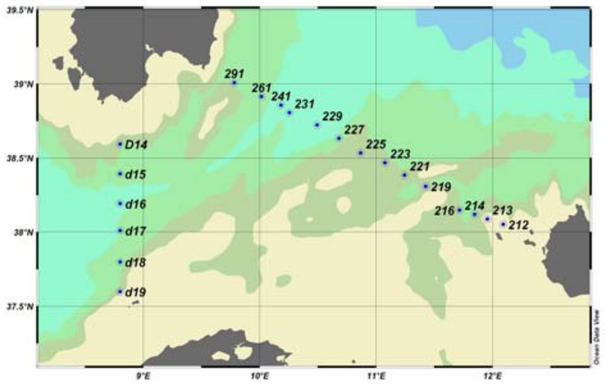


Figure 6.2.2.1. The two CTD transects in the Sardinia channel and Sicily-Sardinia opening

The two sections in the Sicily-Sardinia opening (Figure 6.2.2.2) and Sardinia channel (Figure 6.2.2.3) for temperature (top left), salinity (top right) and dissolved oxygen (bottom) follow.

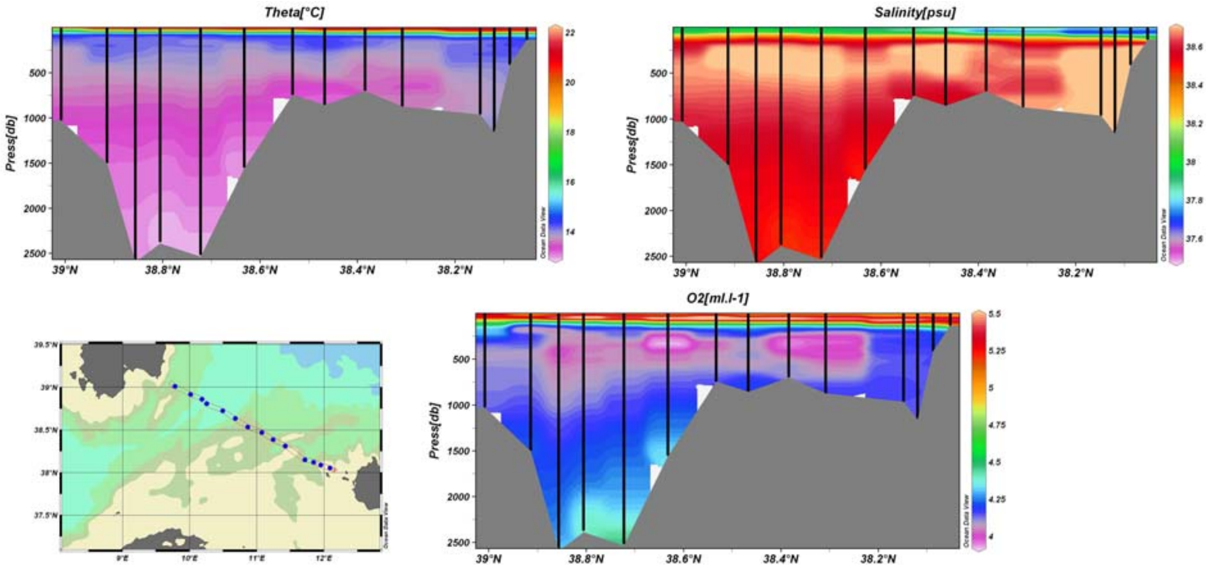


Figure 6.2.2.2. The section in the Sicily-Sardinia opening for temperature (top left), salinity (top right) and dissolved oxygen (bottom)

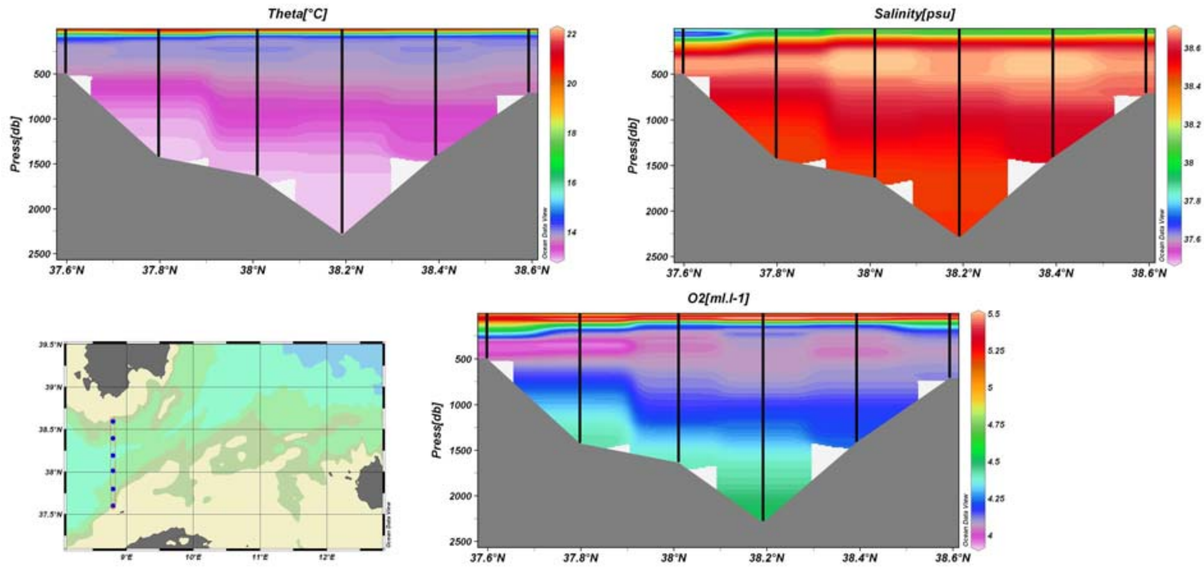


Figure 6.2.2.3. The section in the Sardinia channel for temperature (top left), salinity (top right) and dissolved oxygen (bottom)

In the Sardinia channel (Figure 6.2.2.3.) the presence of the new deep waters in its deepest and central stations is clear, as in minimal part, also along the Sicily-Sardinia opening, connecting the western basin with the Tyrrhenian sea.

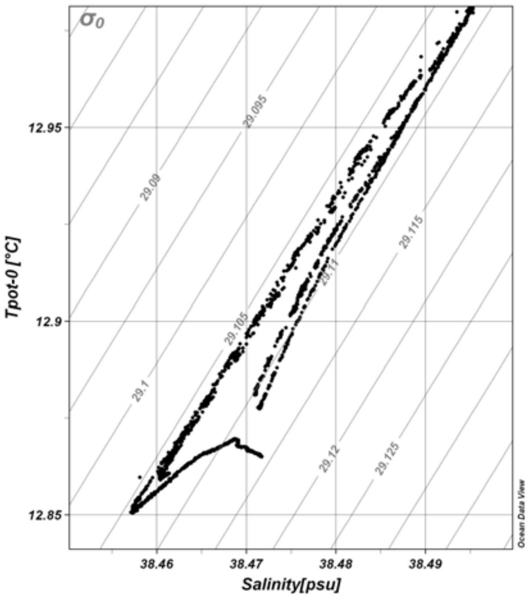


Figure 6.2.2.3.The TS shows the presence of the new deep waters along the transect in the Sardinia channel as, less, along the Sicily-Sardinia opening

Here below the transect with the XBTs in the area.

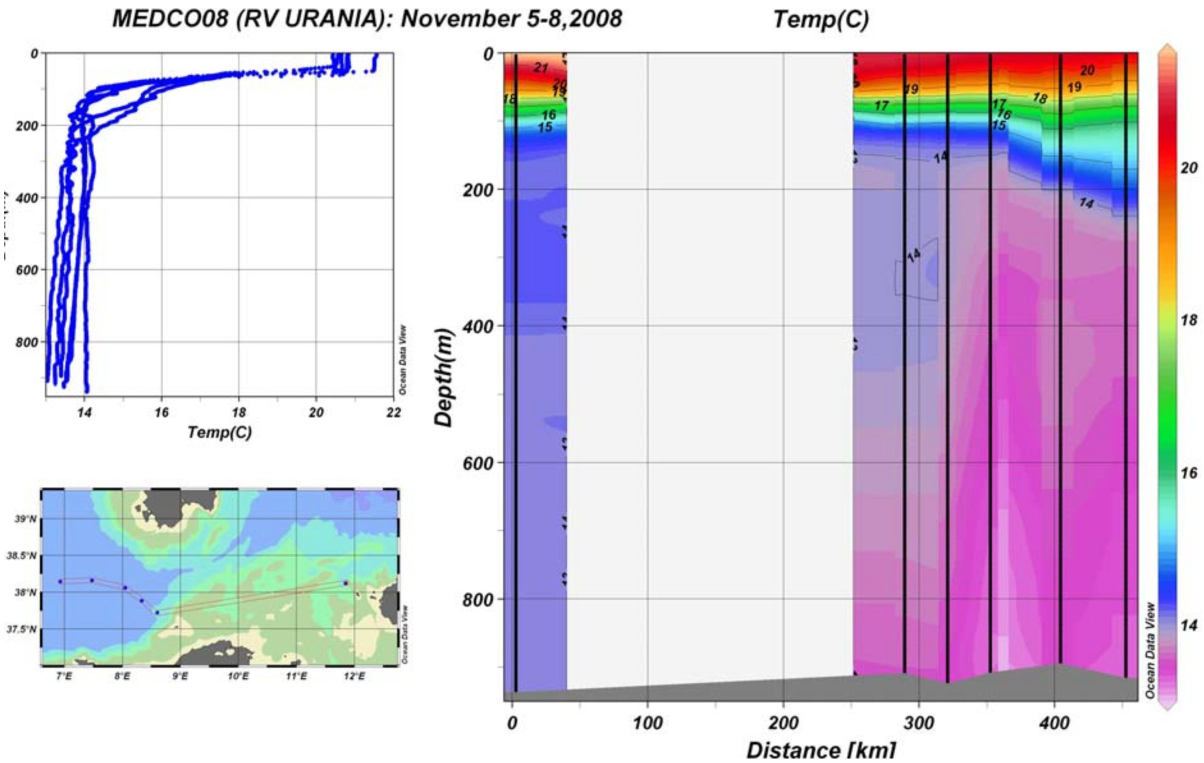


Figure 6.2.2.4.The map, section (inverted) and profiles of the XBTs done in the area of the central Mediterranean.

6.2.3 Algerian basin

The transect along the Algerian basin is characterised by the path of the Algerian current moving, in the upper layers, from west to east along the African coast, and by its instability with the formation and death of mesoscale eddies, some of them reaching over 1000 m depth and 3 years of life.

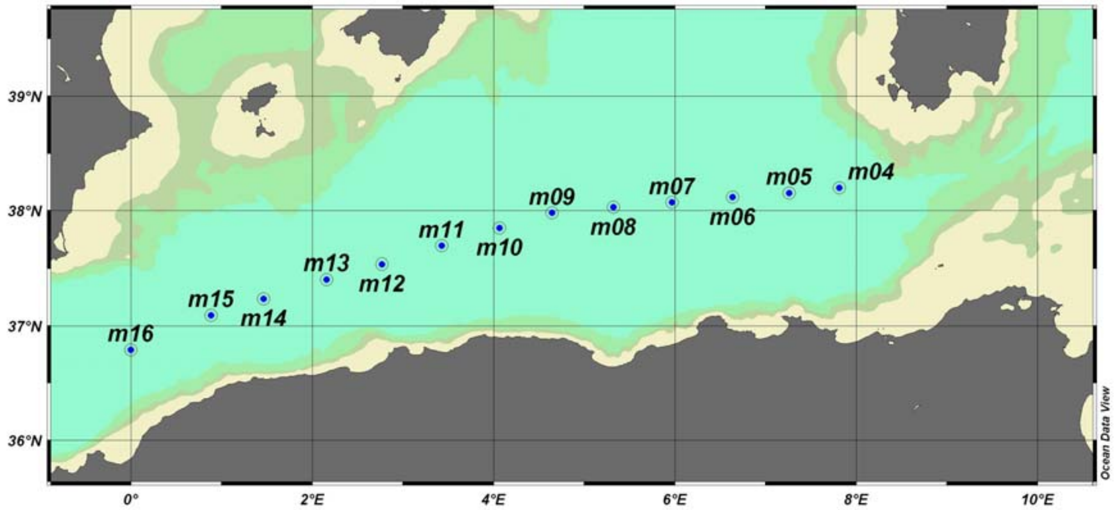


Figure 6.2.3.1. The CTD transect in the Algerian basin

The data show the presence of the new deep waters covering part of the bottom over 1800 m depth as visible in the following Figure 6.2.3.1.

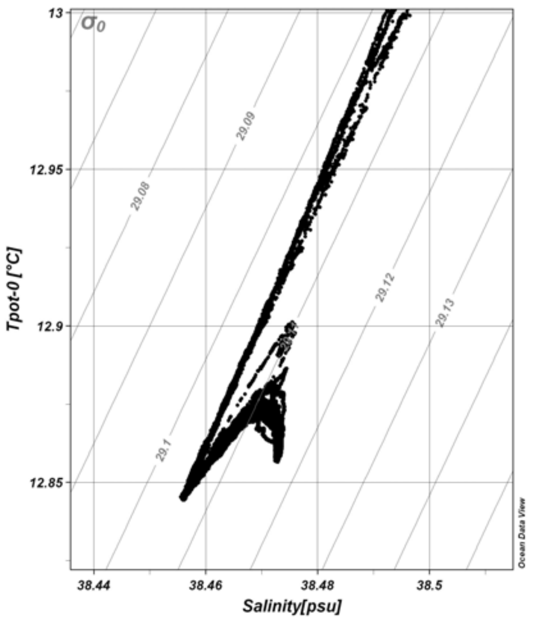


Figure 6.2.3.2 The TS shows the presence of the new deep waters along this transect

About the mesoscale activity in this area, the presence of a large eddy was first evaluated by the results of the forecast model of the western Mediterranean (WMED) and then by the in situ data as visible below in the following two Figures.

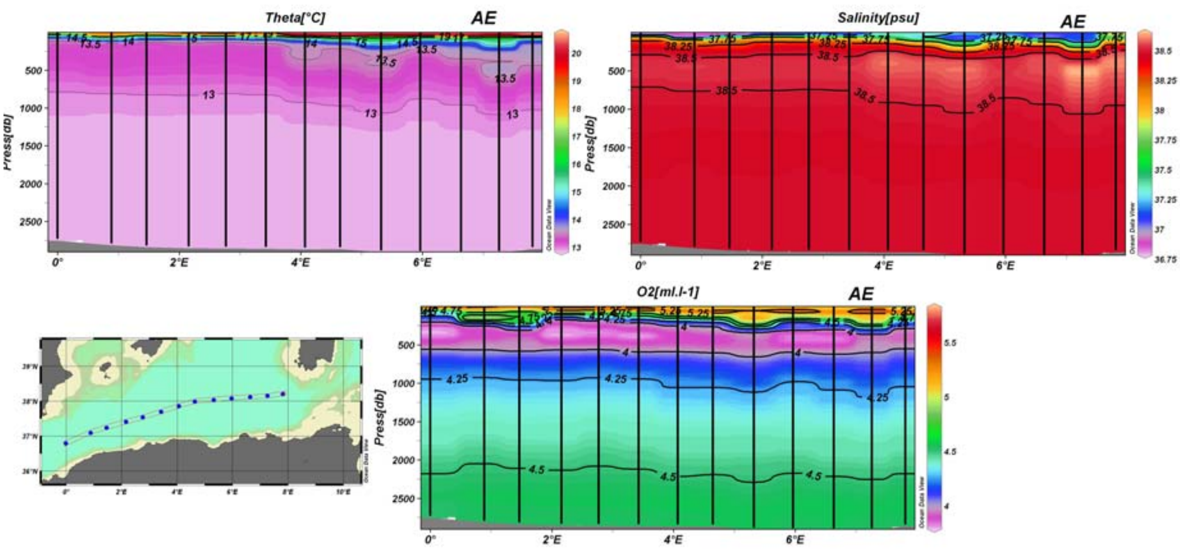


Figure 6.2.3.3 Sections of temperature (high left), salinity (high right) and dissolved oxygen (bottom). All figures show an anti-cyclonic eddy (AE) at heir left side.

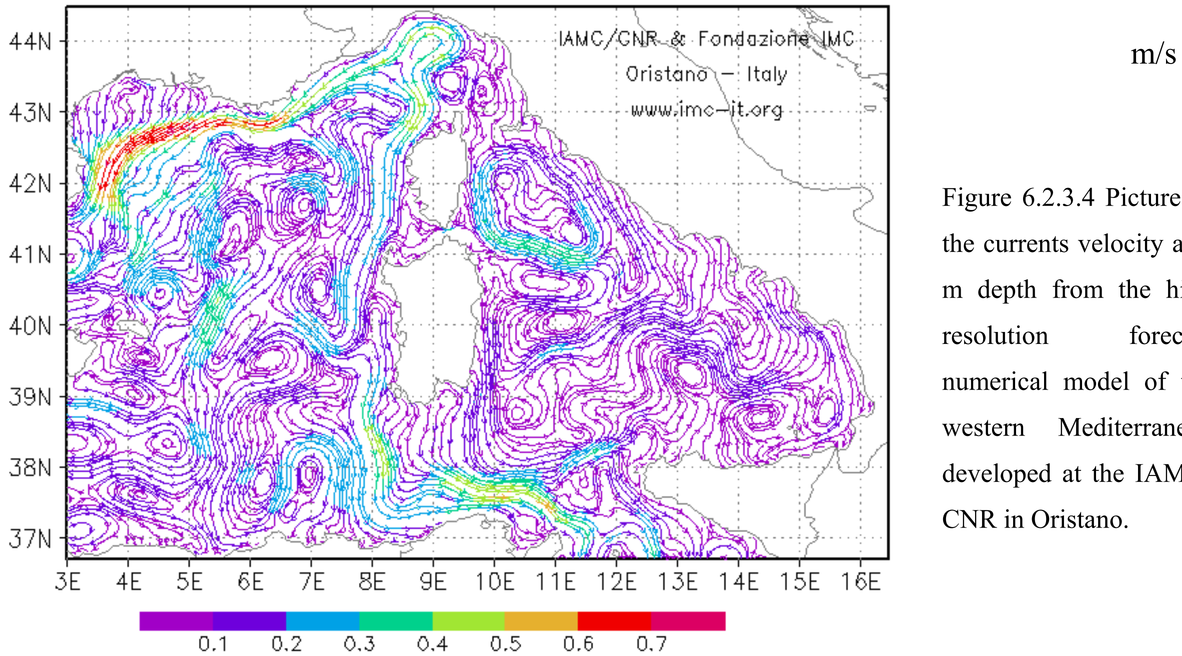


Figure 6.2.3.4 Picture of the currents velocity at 5 m depth from the high resolution forecast numerical model of the western Mediterranean developed at the IAMC-CNR in Oristano.

Here below the transect with the XBTs in the area.

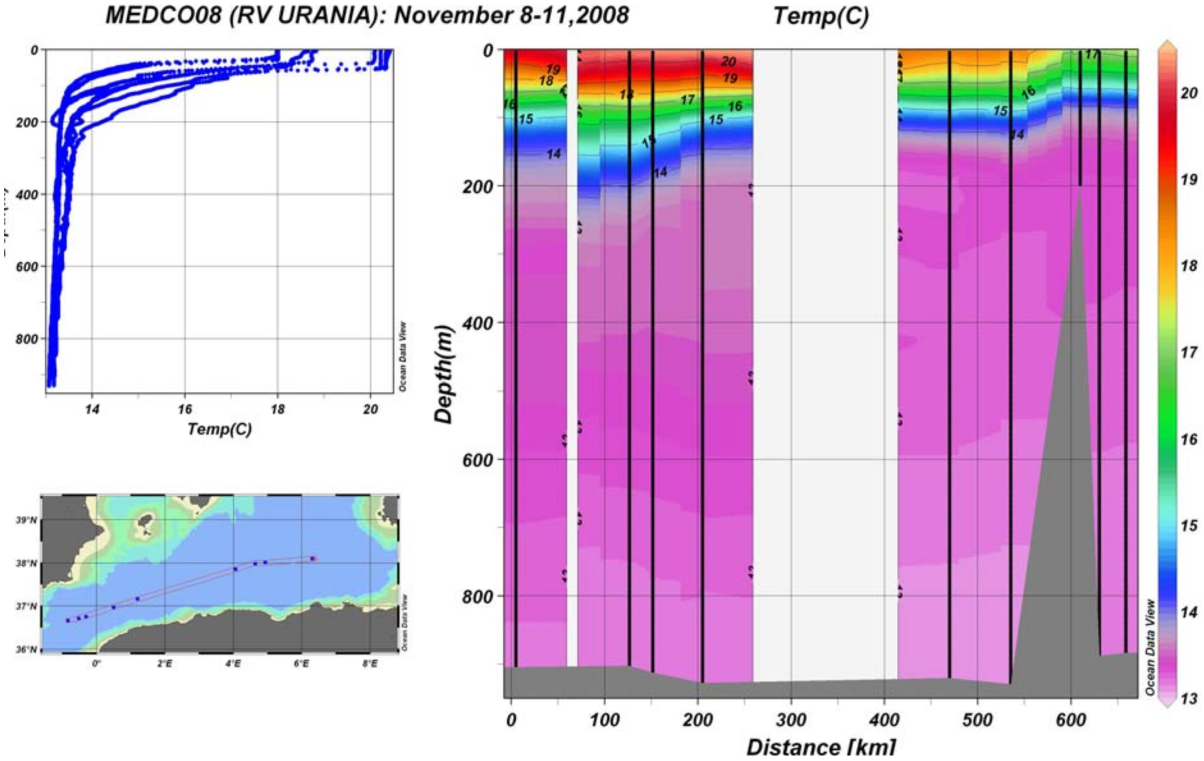


Figure 6.2.3.5.The map, section (inverted) and profiles of the XBTs done in the area of the Algerian basin.

6.2.4 Alboran sea and Gibraltar strait

The Alboran sea is characterised by a permanent eddy in front of the Gibraltar strait that helps the intermediate and deep waters to go up and cross the strait to the Atlantic ocean.

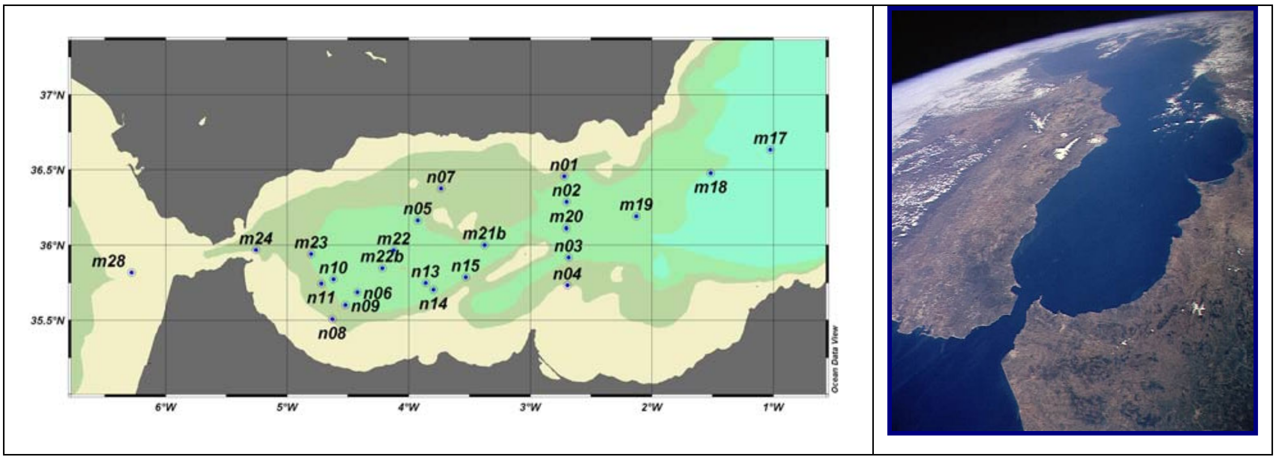


Figure 6.2.4.1. The CTD stations in the Alboran sea (left) and a view from space (right, from NOAA)

Also in this case, the data show the presence of the new deep waters covering the southern part of the Alboran sea on bottom over 1300 m depth as visible in the following Figure 6.2.4.2.

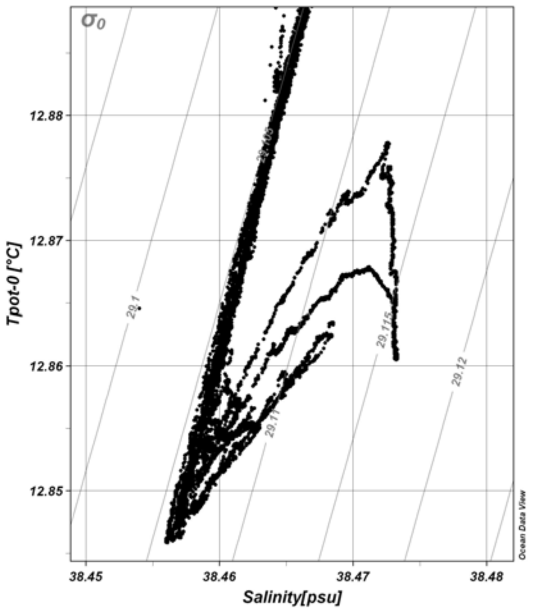


Figure 6.2.4.2 The TS shows the presence of the new deep waters along this transect.

Here below the transect with the XBTs in the area.

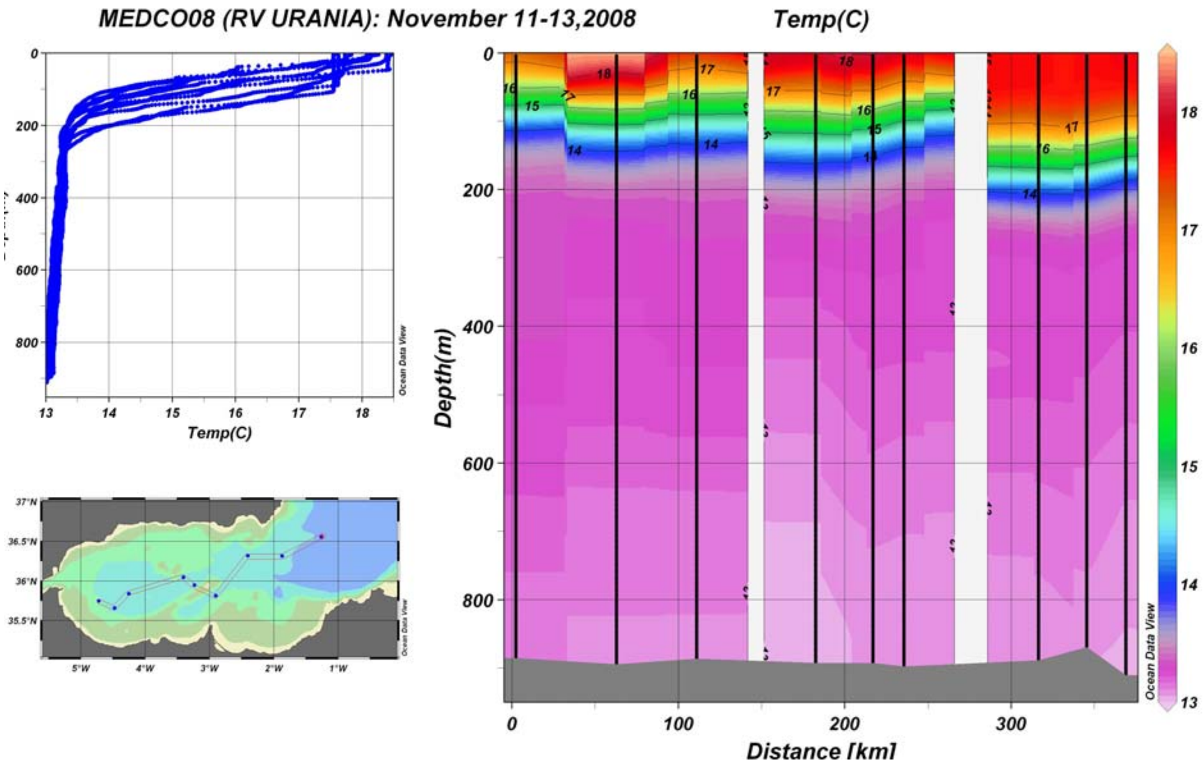
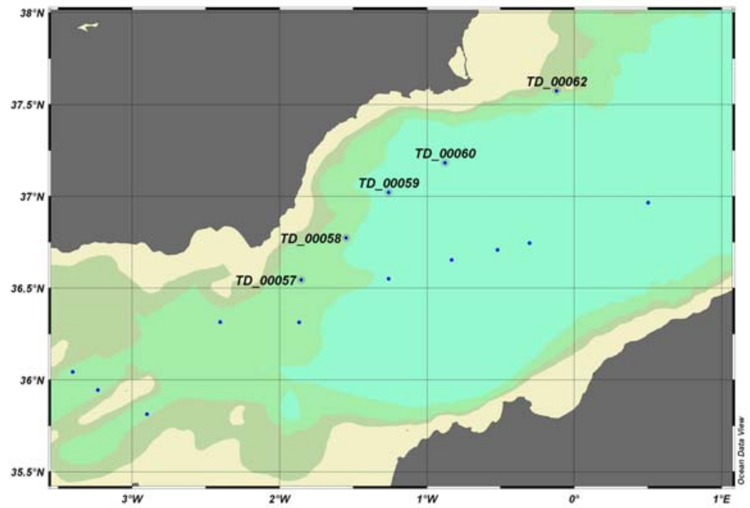


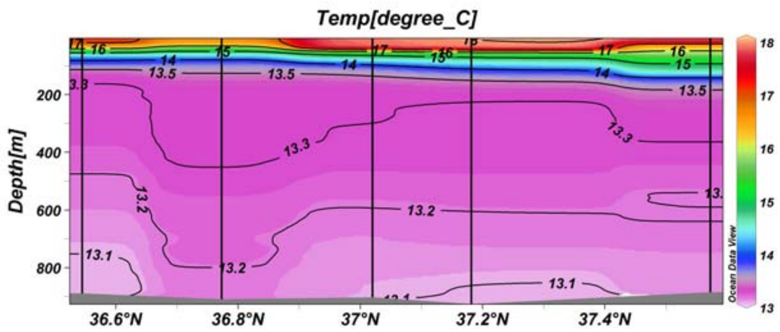
Figure 6.2.4.3.The map, section (inverted) and profiles of the XBTs done in the area of the central Mediterranean.

6.2.5 Transect exit Alboran sea – south Balears

Along the trip from the Alboran sea to Minorca (Balears), several XBTs have been done. The map with their positions and the section of temperature follow.



a)



b)

Figure 6.2.5.1. Position (a) and section (b) of the XBT during the transfer to Balears.

6.2.6 Transect Balears - Sardinia

Due to bad weather conditions it was possible to do one cast (N18) between Minorca islands (Balears) and north-western Sardinia (Figure 6.2.6.1.), deleting the planned transect Minorca – Oristano (Sardinia).

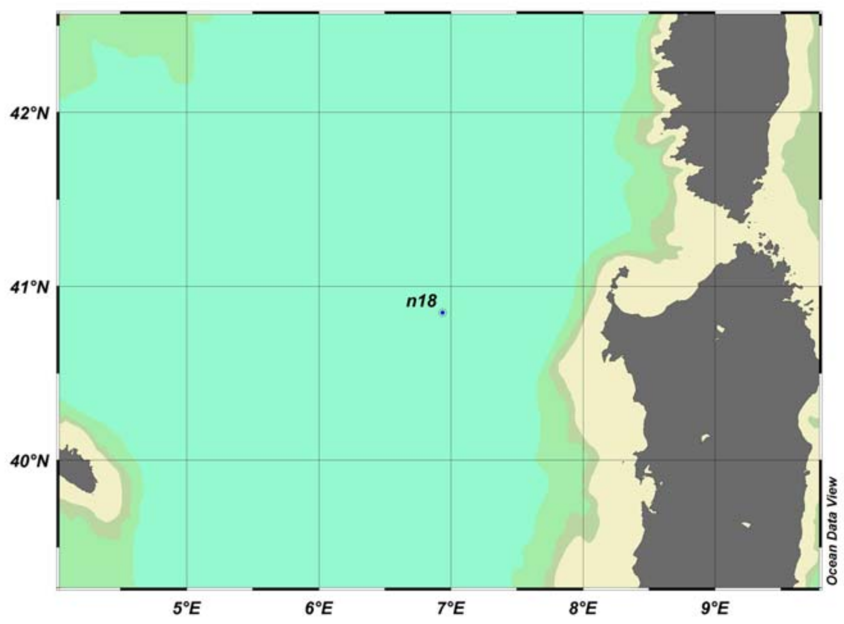


Figure 6.2.6.1. The position of the station N18

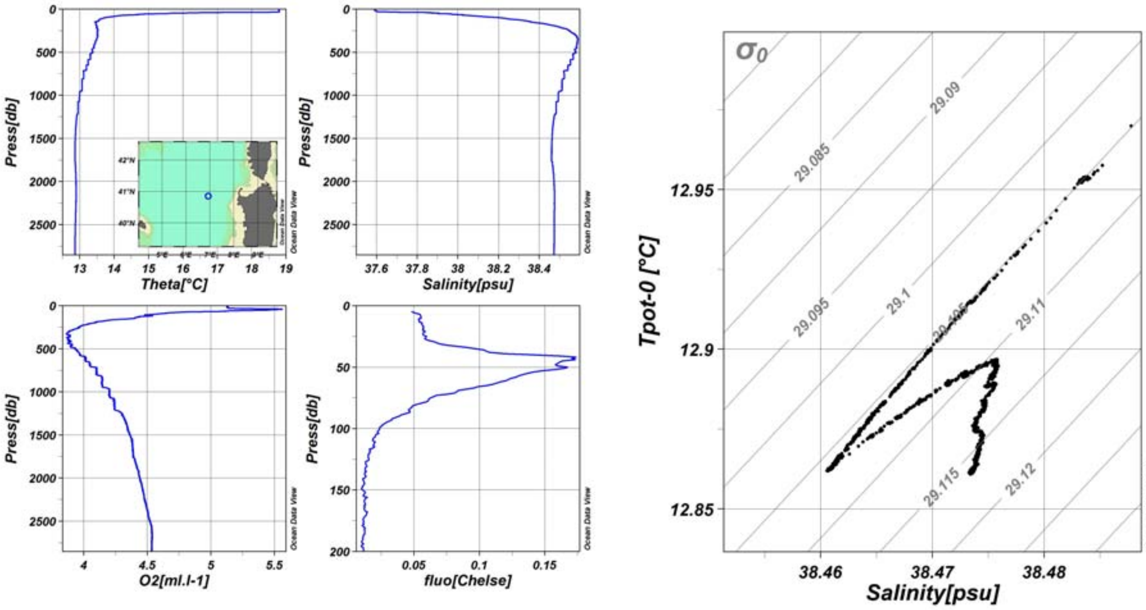


Figure 6.2.6.2. The CTD profiles (4 left) and the TS (right) for the deep waters along the station N18

Anyway, during the transfer several XBTs have been launched in order to have a temperature profile.

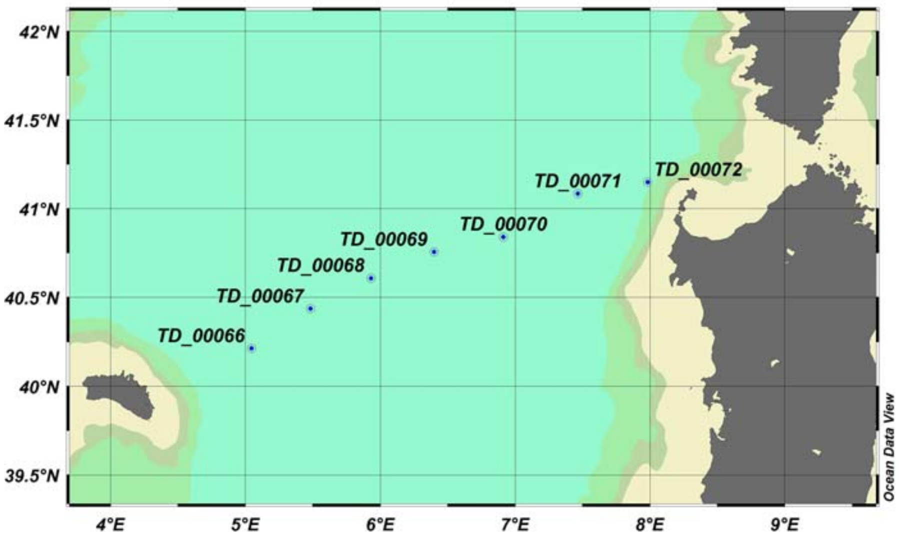
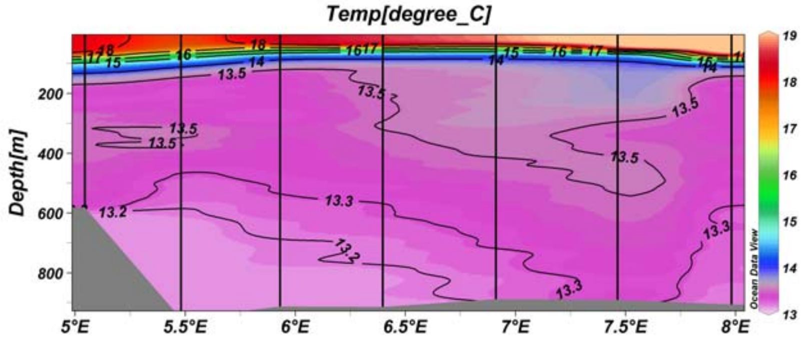


Figure 6.2.6.3. The position of the XBTs along the transect



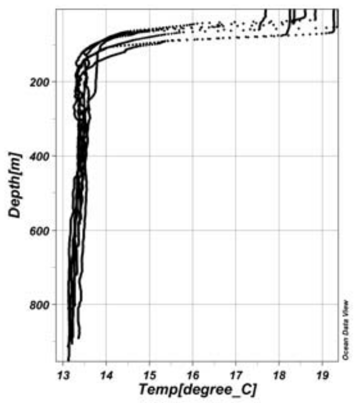


Figure 6.2.6.4. Section (left) and profiles (right) along the transect

6.2.7 Corsica channel

After the recovery and bifore the re-deployment of the mooring COR in the Corsica channel, fouir CTD stations have been done. Map and sections follow.

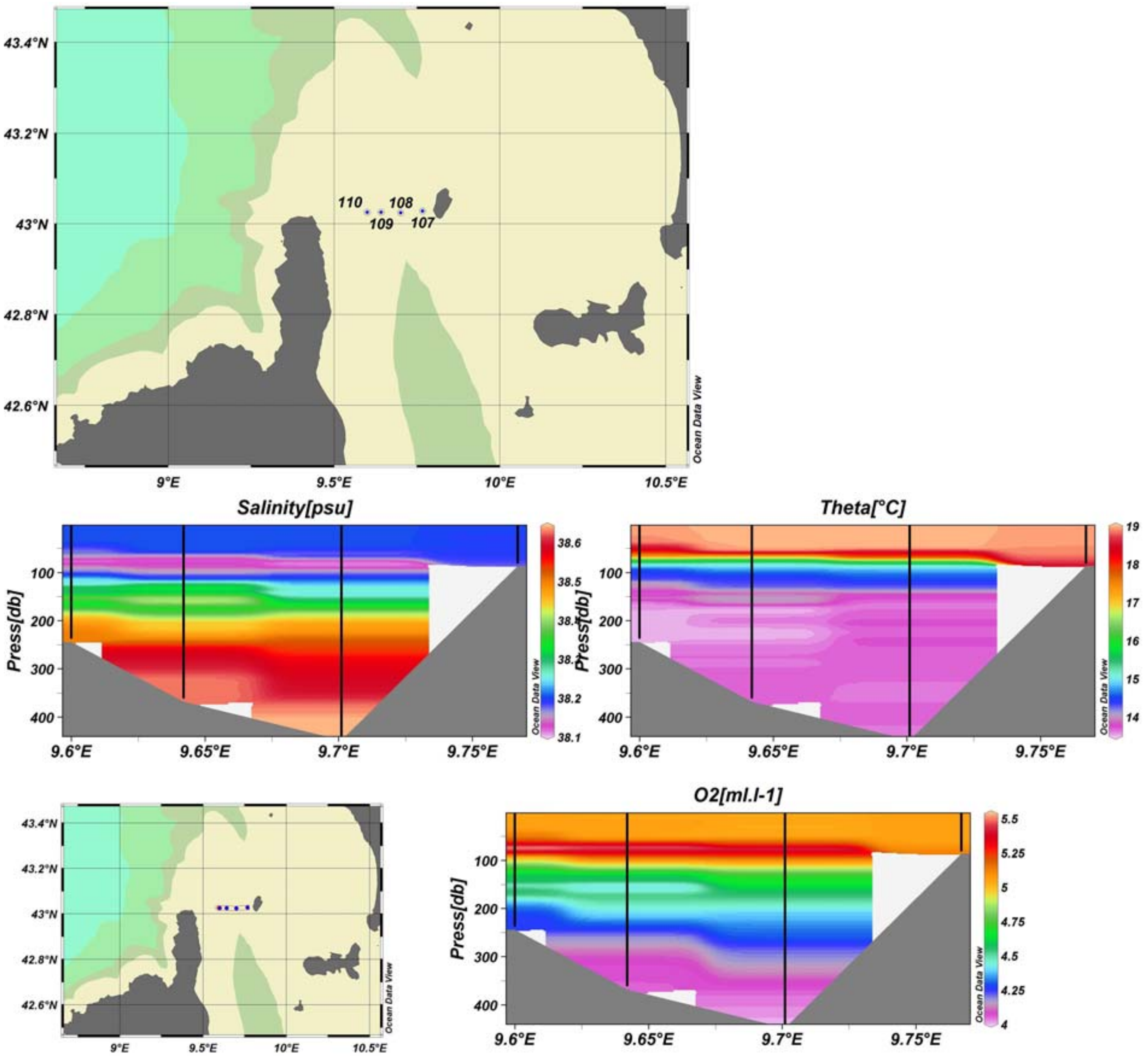


Figura 6.2.7.1. Map (up) and sections (salinity, potential temperature and dissolved oxygen) along the short transect in the Corsica channel

6.3 Moorings

6.3.1 Western Ionian sea

In the western Ionian sea the mooring is known as KC1 (Figure 6.3.1.1).

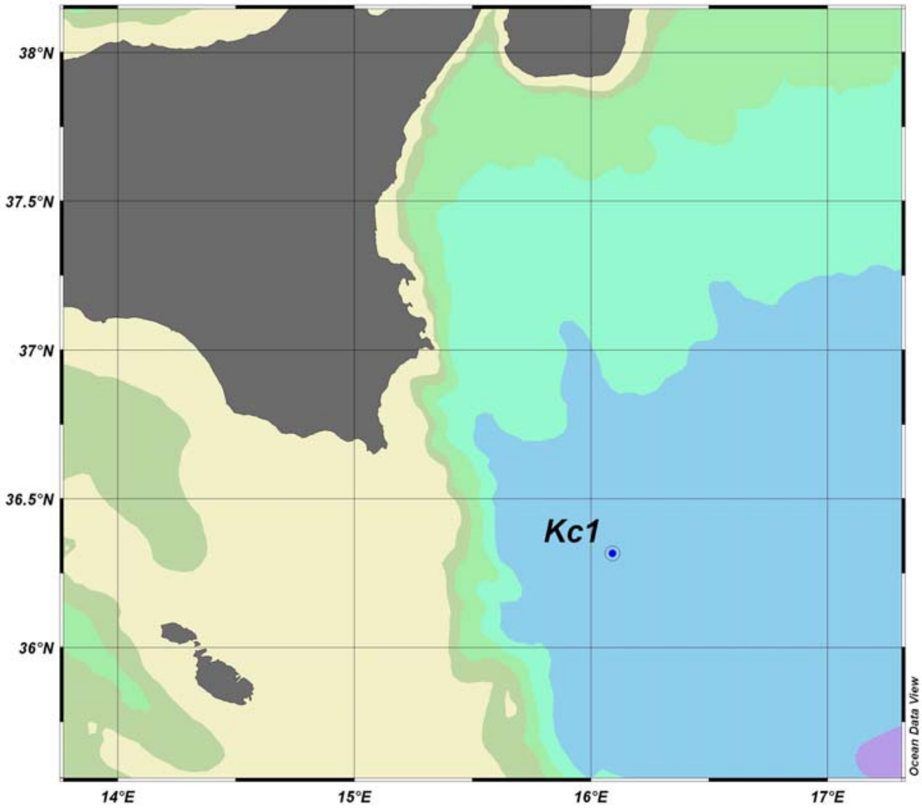


Figure 6.3.1.1. The position of the mooring KC1

In the following the coordinates of the mooring are shown:

Mooring	Longitude [° ‘E]	Latitude [° ’N]	Bottom [m]	Date [dd/mm/yy]	Mooring length [m]
KC1	16 05.464	36 18.978	3365	04/11/2008	1520

Table 6.3.1.1. The position of the mooring KC1

The mooring was composed (Figure 6.3.1.2.) by:

- 12 underwater floating buoys at different depths;
- 1 ARGOS transmitter SM 200X at the top of the mooring;
- 1 currentmeter Aanderaa RCM8 20 m below;
- 1 currentmeter Aquadopp Nortek 579 m from the top;
- 1 SBE19 CTD probe 20 m below at about 3100 m of depth;
- 1 radiometer with batteries 220 m below the CTD at about 3322 m of depth;
- 16 metal plates for studies on corrosion at 3342 m of depth;

- 1 double underwater acoustic release 20 m below and 35 m from the bottom.

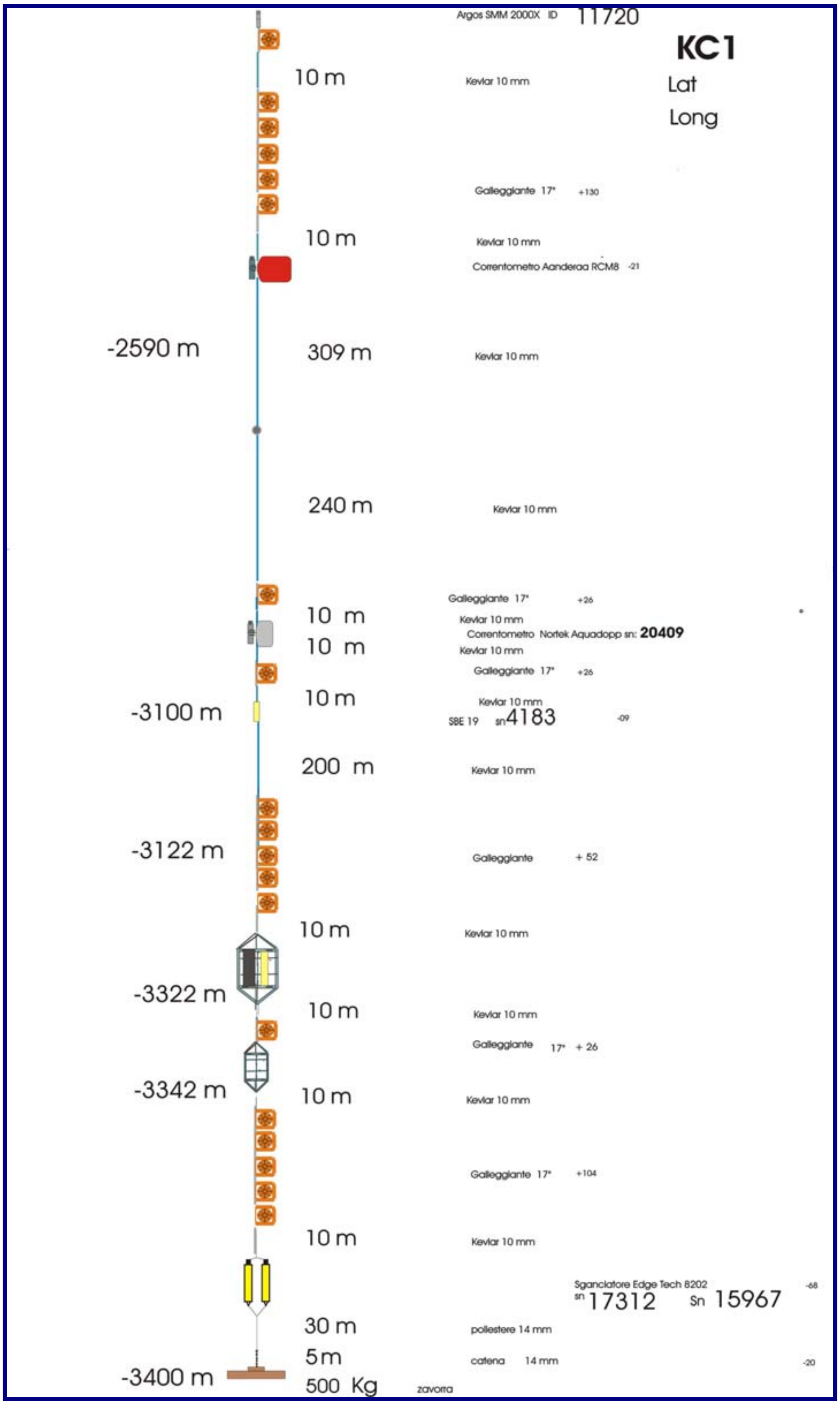


Figure 6.3.1.2. The mooring KC1

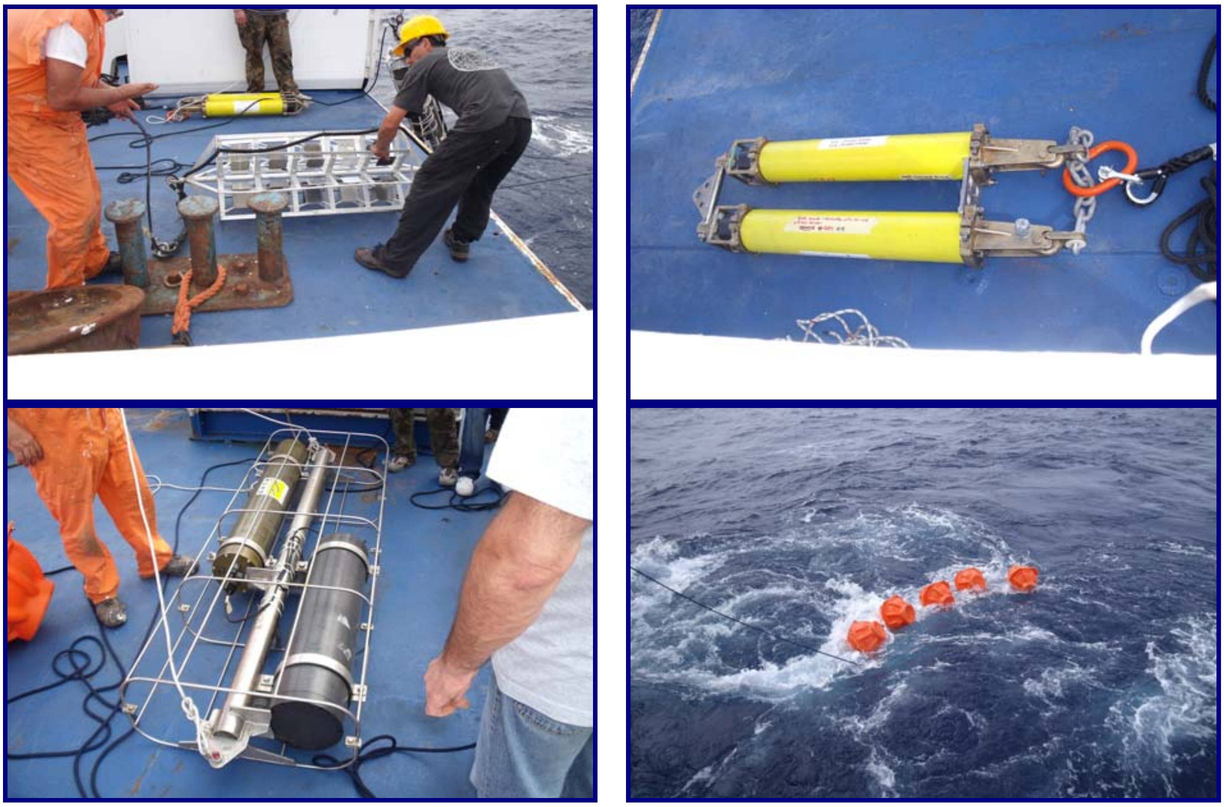


Figure 6.3.1.3. Four images of the mooring KC1: acoustic release and metal plates (top left), acoustic releases (top right), GEMS radiometer in green and batteries in grey (bottom left), five orange underwater floating buoys (bottom right)

GEMS (Figure 6.3.1.3.), after functional check-up, warm up of about 3 hours, calibration and setting operation, was deployed with the whole mooring chain at 10.30 a.m. UTC.

Operations on GEMS started at 5.00 a.m. UTC. Simultaneously, researchers proceeded with seawater sampling, respectively at the seabottom level, at radiometer depth, at 50 meters above radiometer, in 1,5 liters amount for sample, for radiometric analysis with direct methods. GEMS was setted for a six months Stand- Alone acquisition.

6.3.2 Corsica channel

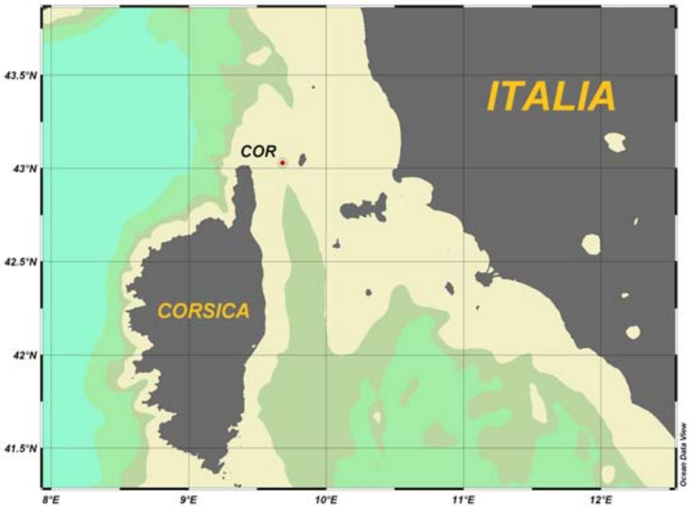


Figure 6.3.2.1. Location of the COR mooring in the Corsica Channel

In the following table the coordinates of the mooring are shown:

mooring name	Longitude [° ‘E]	Latitude [° ’N]	Bottom [m]	Date [dd/mm/yy]	Mooring length [m]
COR	009 41.123	43 01.766	440	24/10/2007	378

The mooring was structured (see figure 6.3.2.2), from the top to the bottom, with a buoy with satellite Argos SMM 2000X ID transmitter.

Then these instruments follow (figure 6.3.2.2): a floating buoy Billing <37 inches in diameter, a mechanical correntmeter RCM7, two acoustics currentmeters RCM9, one CTD SBE37, 7 floating buoys of 17 inches in diameter, one double underwater acoustic release Edge Tech 8202. Instruments and floats are then kept together by a 10 mm Kevlar or a 14 mm poliester cable, by a 14 mm chain moored to the bottom through two 300 kg train wheels.

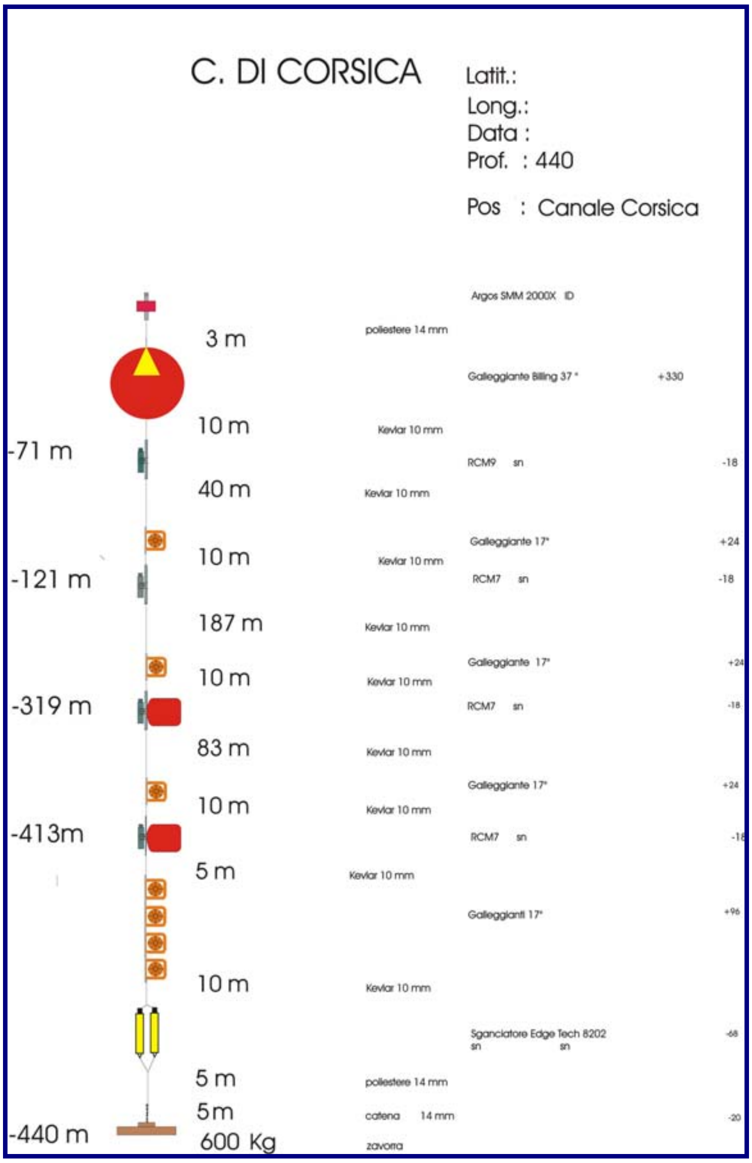


Figure 6.3.2.2. Structure of the mooring COR in the Corsica Channel

6.4 Optical properties of the west Mediterranean waters.

Preliminary results of the measurements of optical properties of the west Mediterranean waters are shown in this section. Spectra of underwater irradiance (400-700 nm) measured by means of spectroradiometer LICOR-LI1800UW in M14 station are shown in Figure 6.4.1. Also the spectra of reflectance of the water field is shown.

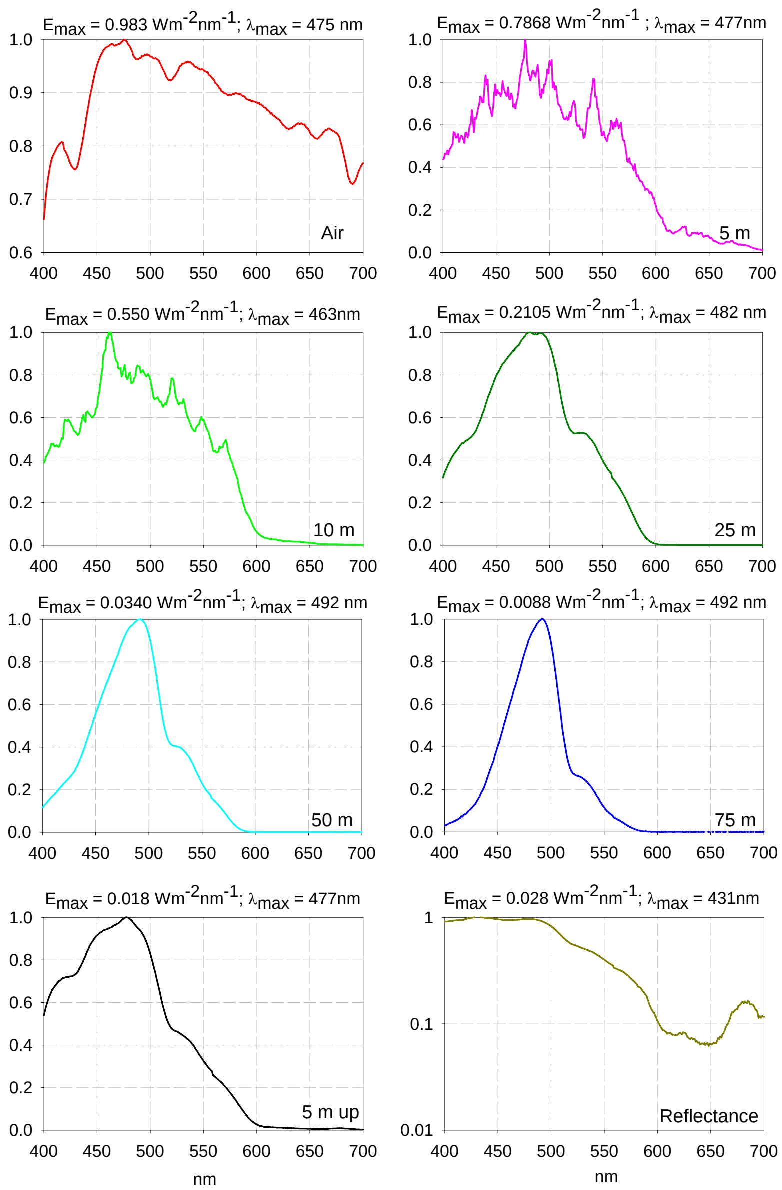


Figure 6.4.1. Maximum-normalized spectra of downward, upward (5 m) irradiance and reflectance at M14 station (10/11/2008).

The vertical profile of PAR, UV-A (380 nm), UV-B (305 nm), natural fluorescence and chlorophyll *a* are shown in figure 6.4.2. The vertical profile of PAR is computed as per cent ratio with surface PAR to evaluate the depth of the euphotic zone (Z_{eu}).

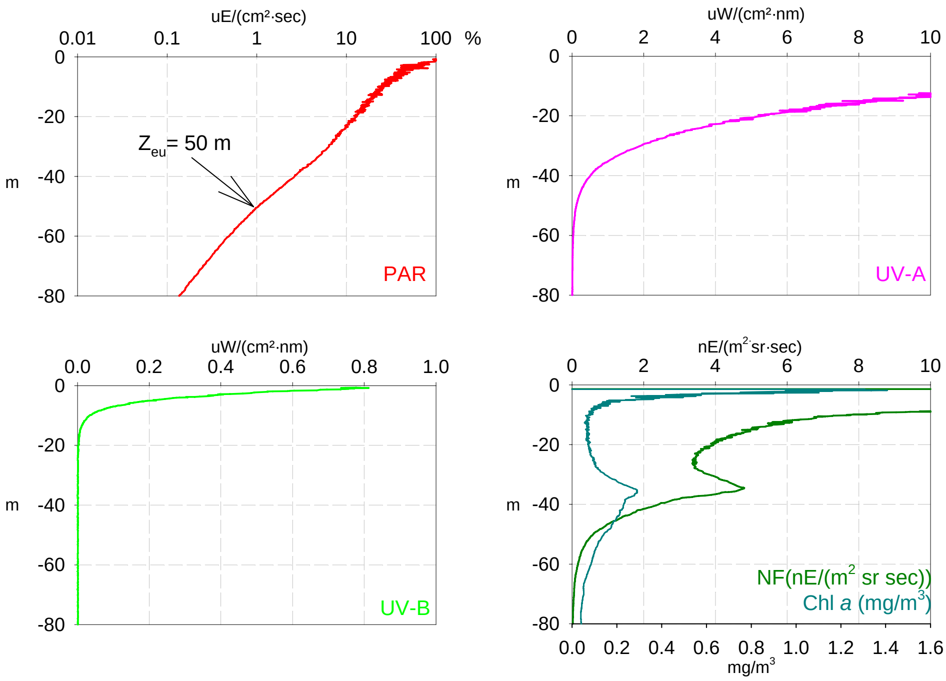


Figure 6.4.2. Vertical profile of PAR, UV-A e B irradiance, natural fluorescence (NF) and chlorophyll *a* at the station M14 (10/11/2008).

Attenuation and absorption coefficients measured by means of spectro-photometer ac-9 at M14 station are shown in figure 6.4.3.

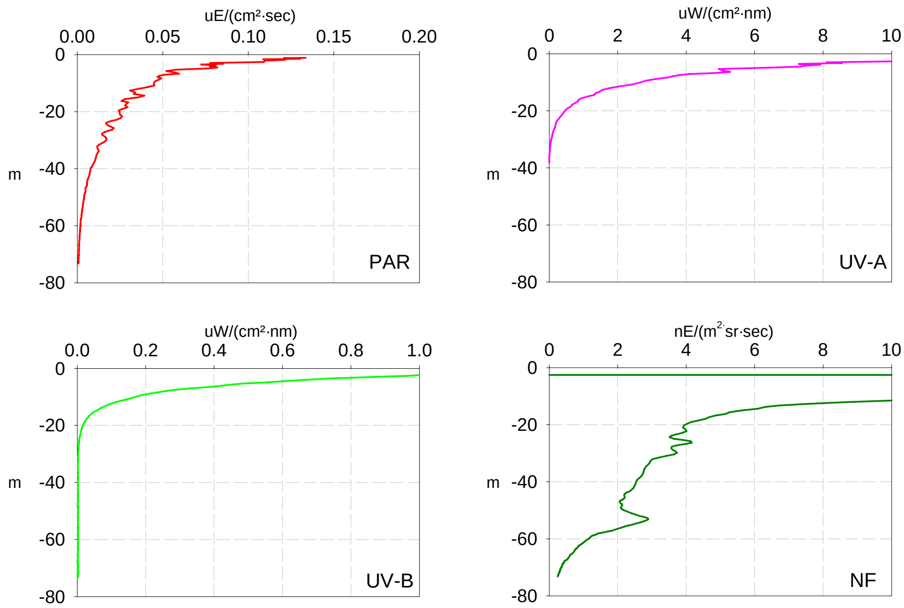


Figure 6.4.3. Spectra of absorption (a(λ)) and attenuation (c(λ)) coefficients at the station M14 (10/11/2008).

These measurements of irradiance will be correlated with taxonomic (examination under the microscope) and pigmentary (HPLC) composition of phytoplankton assemblages, with the different absorption and back-scattering properties of phytoplankton, detritus and yellow substance.

Water samples at different depth, which have been chosen in relation with the vertical profile of temperature, salinity, oxygen and above all fluorescence (CTD probe), have been taken in all stations and used for several analysis.

1. A quote of 4 L has been filtered on glass-fiber filter GF/F Whatman (∅ 47 mm). Particulate collected on filter has been frozen at -20 °C and then, at laboratory on land, it will be used to estimate chlorophyll *a* and carotenoids concentrations (HPLC analysis). A quote of filtered sample (100 mL) has been fixed with $HgCl_2$ for nutrients analysis (NO_2^-, NO_3^-, NH_4^+, PO_4^-), while a quote (150 mL) of filtered sample has been fixed with NaN_3 for yellow substance analysis.
2. A quote of 4 L has been filtered on glass-fiber filter GF/F Whatman (∅ 25 mm) and then frozen at -20 °C for particulate absorption analysis. On land analysis will be done by means of spectroradiometer LICOR LI-1800UW equipped with an integrating sphere. Measurements before and after pigment extraction in methanol could discriminate phytoplankton absorption spectra from the detritus ones.
3. A quote of 4 L has been filtered on glass-fiber filter GF/F Whatman (∅ 47 mm) previously ignited and weighed for analysis of suspended particulate. Filters have been stored at +4°C.
4. A quote of 4 L has been filtered on PC filter (∅ 25 mm, porosity 0.4 µm) for particulate back-scattering analysis and then they have been stored at -20 °C.

Not-filtered quotes have been taken to examine phytoplankton assemblages under the microscope (250 mL fixed with formaldehyde) and to evaluate entire N and P contents (100 mL fixed with $HgCl_2$).

Table 6.4.1 shows sampled stations and the collected samples.

Station	Chl Nutrients	Phytoplankton	Particulate absorption/ CDOM/ N-P tot	Suspended particulate/ Particulate backscattering	LICOR LI1800UW/ PUV 510B/ ac-9
KC1	X	X	X	-	-
212	X	X	-	-	-
214	X	-	-	-	-

219	X	-	-	-	-
223	X	-	-	-	-
227	X	X	X	-	-
229	X	X	X	X	X
231	X	X	-	-	-
261	X	X	-	-	-
D15	X	X	X	X	X
D16	X	-	-	-	-
D17	X	-	-	-	-
M4	X	X	X	-	-
M5	X	X	X	X	X
M6	X	X	-	-	-
M9	X	X	X	X	X
M11	X	-	-	-	-
M14	X	X	X	X	X
M16	X	X	-	-	-
M17	X	X	X	-	-
M18	X	X	-	-	-
M19	X	X	X	X	X
N1	X	-	-	-	-
M20	X	X	-	-	-
N4	X	-	-	-	-
M21b	X	-	-	-	-
N10	X	X	X	X	X
N7	X	X	X	X	X
M23	X	-	-	-	-
109	X	X	X	X	X (only ac-9)
110	X	X	-	-	-
108	X	X	-	-	-
107	X	X	X	X	X (only ac-9)

Table 6.4.1 – Stations done by Firenze University during de MedCO08 cruise.

6.5 Chirp activities

6.5.1 Drilling site in the western Alboran Sea

A location, as drilling site, in the western Alboran Sea between station M22 (4.12° W, 35.97° N; 1364 m) and station M23 (4.80° W, 35.94° N; 1017 m), was chosen for micropalaeontological (benthic and planktonic foraminifera, calcareous nannofossils) and geochemical investigations. The Alboran Sea has been intensively investigated and represents an important reference for high-resolution palaeoceanographic studies in the Mediterranean Sea. Foraminifera, calcareous nannofossils, pollen, and geochemical data collected from core MD95-2043 and on Ocean Drilling Program (ODP) Site 977 (Figure 6.5.1.), allowed an understanding of the climatic-environmental transformations undergone by the western Mediterranean since the last glacial period (Cacho et al., Paleoceanography 1999, Earth and Planetary Science Letters 2000; Combourieu Nebout et al., Geology 2002; Pérez-Folgado et al., Marine Geology 2003; 2004; Colmenero-Hidalgo et al., Palaeogeography, Palaeoclimatology, Palaeoecology 2004; Moreno et al., Palaeogeography Palaeoclimatology Palaeoecology 2004, Quaternary Science Reviews 2005).

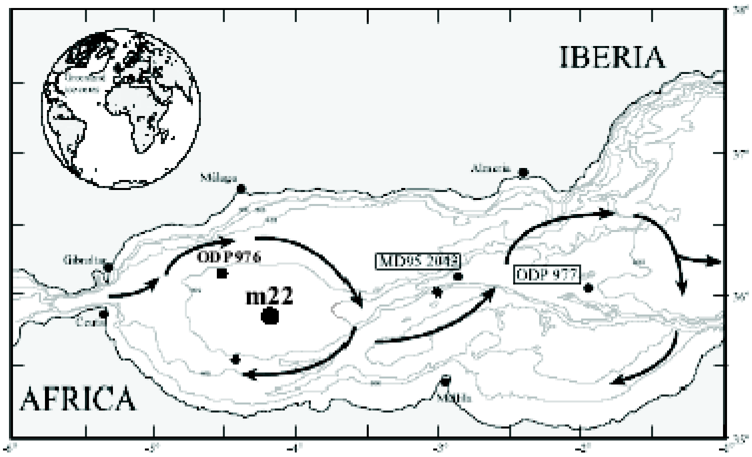


Figure 6.5.1. Location of the Leg 161, Site 976, in the western Alboran Sea

One of the sites drilled during Leg 161, Site 976, is also located in the western Alboran Sea (Figure 6.5.1.). Micropalaeontological and geochemical data acquired from the cores at this site were focused not on the last glacial/Holocene interval, but on a more general framework dealing with the Plio-Pleistocene sedimentary record (Capotondi and Vigliotti, Proceedings of the Ocean Drilling Program, Scientific Results 161 1999; de Kaenel et al., Proceedings of the Ocean Drilling Program, Scientific Results 161 1999).

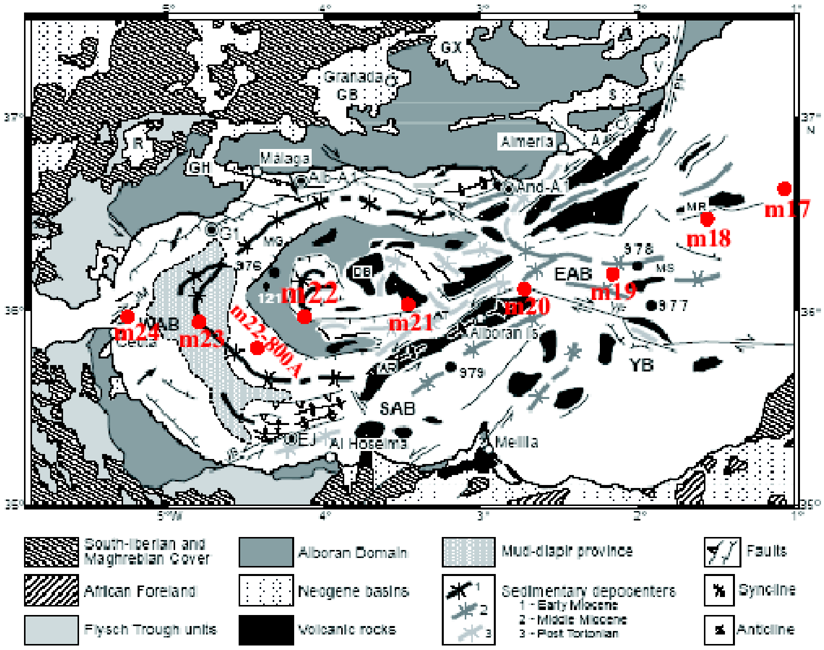


Figure 6.5.2. Hydrological stations (m17-m23) and of the drilling site (m22-800A) in the Alboran Sea

Thus, the expected high-resolution (millennial scale) biological and geochemical analysis of the core recovered during cruise MEDOC08 could represent an original line of research. With respect to the eastern Alboran sea cores, core M22-800A (04°23.991'W, 35°48.010'N; 1460.1 m depth) is located in the proximity of the Gibraltar Strait, within the first of two anticyclonic gyres that characterise the area (Figure 6.5.1.). It was recovered on the Quaternary sediments between the metamorphic Alboran Domain and the mud-diapir province (Figure 6.5.2.) (Comas et al., Proceedings of the Ocean Drilling Program, Scientific Results 161 1999; Soutkin et al., Marine Geology 2003). The core location was chosen after investigation using a 3.5 kHz sub-bottom profiler (Chirp) that corroborated the occurrence of Quaternary sediments (Figure 6.5.3.).

Figure 6.5.3. Chirp profile between N11-M22 in the Alboran Sea

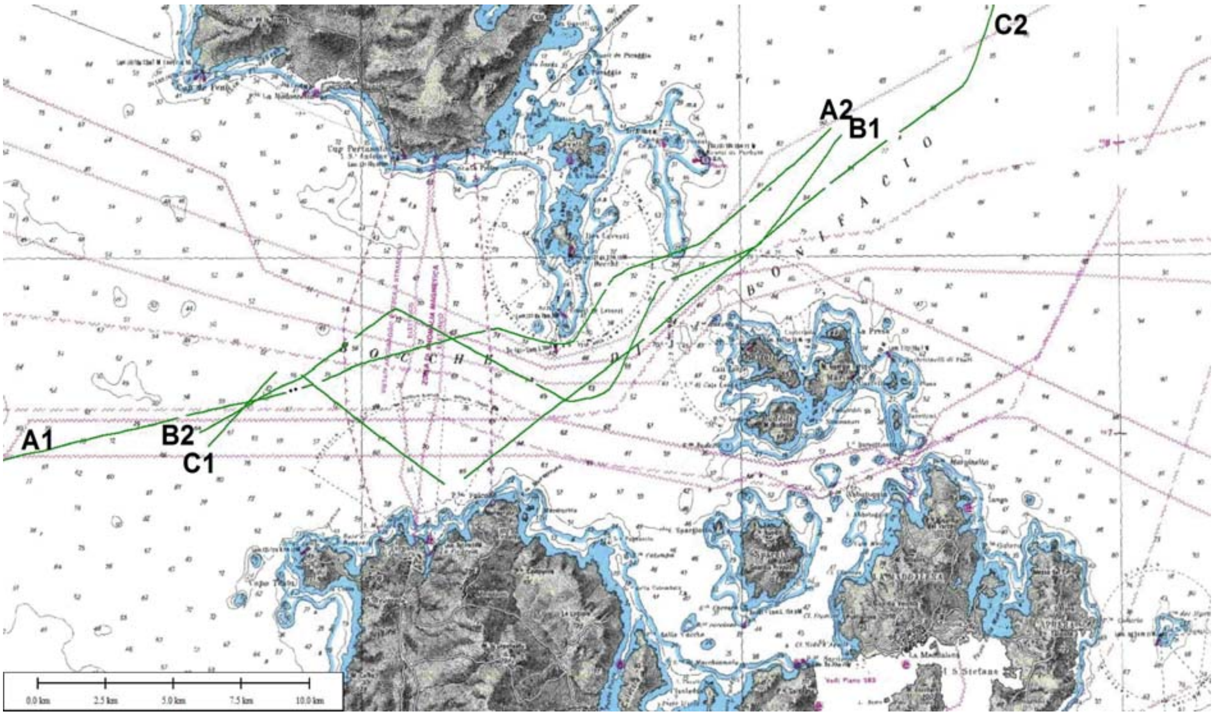
The sediments of core M23-800A may have recorded calcareous planktonic changes of surface waters coming from the Atlantic Ocean whose physicochemical properties would still be unaltered. Moreover, it should be possible to obtain information on the physicochemical properties of MOW through the study of stable isotopes of planktonic foraminifera that occupy a relatively deep part of the water column, for instance *Globorotalia inflata, Globorotalia truncatulinoides,* and *Neogloboquadrina pachyderma* (Rohling et al., Marine Micropaleontology 2004). Finally, data on the benthic foraminifera assemblages and on the stable isotopic composition of the same group could provide indications of the evolution of the western Mediterranean deep waters.

Figure 6.5.4. Gravity corer recovery after drilling operation

Drilling operations started at 11:51 (local time), on 14 November 2008 and ended at 15:30. The gravity corer, which was 6 m in length, recovered about 3.60 m of clay (Figure 6.5.4.). A sample of a few grams was taken by the core catcher for preliminary biostratigraphic analysis. The core has been frozen at –4°C and transported to the repository of the CNR-IAMC in Mazara del Vallo (TP).

6.5.2 Chirp in the Bonifacio Mouth

Three acquisition lines has been done in the Bonifacio Mouth along the main passage for bathymetric, geophysical and current data by Multibeam, Chirp and SADCP-WH respectively. The vessel speed was about 5-6 knodes during the first two lines and about 8 knodes during the third. The first and third acquisition was from west (Corsica Sea) to east (Tyrrhenian Sea) while the second from east to west.



In Figure 6.5.2.1 The three lines of acquisition (in green A1-A2; B1-B2; C1-C2)

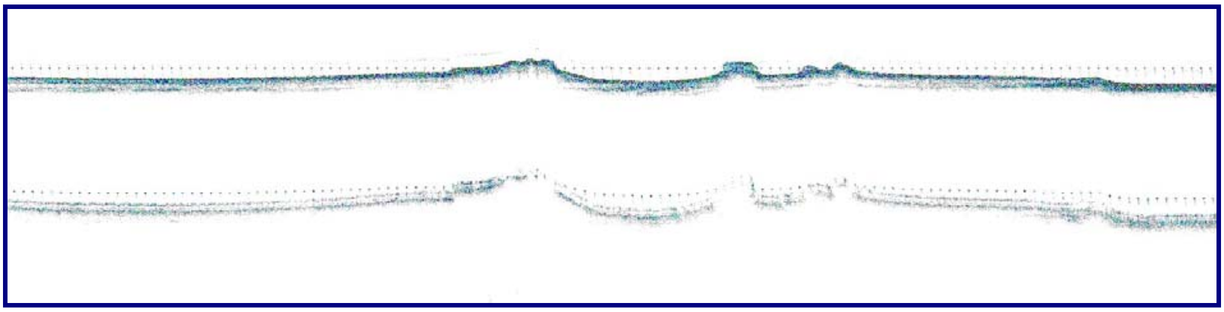


Figure 6.5.2.2 Chirp profile in the Bonifacio mouth

6.6 Marine midrobic microbiology

Microbes are believed to play a large role in marine environments. Microbial community in deep-sea and along water column has poorly been studied. Exactly there are insufficient information about a possible correlation among water mass, depth, and bacterial community composition (Giovannoni, et al. 2000). This approach is essential to study the role of bacteria in marine ecology and their contribution in nutrient and element cycles.

The aim of this research is the quantitative and qualitative analysis of heterotrophic bacteria distribution in western Mediterranean pelagic waters. Heterotrophic bacteria utilize organic compounds. Most of marine bacteria belongs to this kind of bacteria, such as luminous bacteria.

One of the most important factor in heterotrophic microbial distribution in different sea water is organic compounds concentration, particularly sugars and proteins concentration (Rheinheimer, 1977). Therefore, higher values of microbial density are characteristic of the photic layer.

Another important objective of this study was to characterize microbial communities diversity focusing on the metabolically active fraction of the bacterial populations that occurs in some representative layers of the water column (Surface, 200 m, 500 m, 700 m, 800 m, 1000 m, 1500, 2000 m, Bottom) in the same areas. Pure-culture approach to study microbial world, seriously constrained microbial diversity view because most microbes defy cultivation by standard methods. Numerous studies, based on culture-independent methodology, have been carried out to investigate microbes as key player in many environmental processes in the biosphere (Head et al., 1998; Moeseneder et al., 2005). At the moment, molecular phylogenetic studies applied to microbial ecology are based on the analysis of either DNA or RNA, whereas, simultaneous studies on both types of nucleic acids extracted from the same environment are still scarce (Nogales et al., 1999; 2001; Mills et al ., 2005; Moeseneder et al., 2005). To detect bacterial community composition without DNA amplification using 16S rRNA probes we have used CARD-FISH technique, a recently developed catalyzed reporter deposition FISH method that allows the use of oligonucleotide probes (Pernthaler et al., 2002). This approach permits the detection of small marine bacteria with low ribosome content. Eco BIOLOG GN plates were used to characterize the ability of the microbial communities to oxidize various carbon sources. Finally, some enrichments with Crude Oil, PCB and Mercuric Chloride were effected in 5 stations (Table 6.6.1.).

In many stations (Table 6.6.1.) we collected sea water samples at different depth, according to the physical and chemical survey by Niskin bottles.

Station	Viable Counts on MA	Viable Counts on SWC	DAPI	FISH	DNA/RNA	BIOLOG	ENRICHMENTS
KC1	X	X	X				
212	X	X	X	X	X	X	X
214	X	X	X				
219	X	X	X				
227	X	X	X				
229	X	X	X	X	X	X	X
241	X	X	X				
D15	X	X	X	X	X	X	X
M4	X	X	X				
M5	X	X	X	X	X	X	X
M7	X	X	X				
M9	X	X	X	X	X	X	X
M14	X	X	X	X	X	X	X
M17	X	X	X				
M18	X	X	X				
M19	X	X	X	X	X	X	X
N1	X	X	X				
M20	X	X	X				
N4	X	X	X				
M21b	X	X	X				
N7	X	X	X	X	X	X	X
N10	X	X	X	X	X	X	X
M23	X	X	X				
M24			X		X		X
M28	X	X	X	X	X	X	X
GEO					X		X

Table 6.6.1. Sampling sites in western Mediterranean sea.

Acknowledgements

The scientific/technical personnel embarked for the MedCO08 cruise wishes to thank the Consiglio Nazionale delle Ricerche (CNR) for the availability of the R/V URANIA and the Captain Lubrano Lavadera Vincenzo, the Officers and the Crew of the vessel for their help on board.

A large amount of graphs and data analysis in this report has been done by the freeware software ODV – Ocean Data View realised and updated by Dr R. Schlitzer (http:/www.awi-bremerhaven.de/GEO/ODV/2006).

The MedCO08 cruise is organised in the framework of international strategies:

⇒ **GOOS** (*Global Ocean Observing System)* facing three moments of the operational oceanography: measurements, monitoring and modelling. GOOS is sponsored by: IOC, WMO, UNEP and ICSU.

⇒ **MOON** (*Mediterranean Operational Observing Network*) part of the coordinating group of the EuroGOOS Mediterranean Task Team and is responsible of Mediterranean operational oceanography, sea foecast and observation.

⇒ **GNOO** (*Gruppo Nazionanle di Oceanografia Operativa*) created to consolidate and coordinate the activities in operational oceanography in Italy.

⇒ **MedGOOS** (*Mediterranean Global Ocean Observing System)* an association fundede under the auspices of UNESCO/IOC to give support the the Mediterranean GOOS.

⇒ **EuroGOOS** (*European Global Ocean Observing System)* part of the European GOOS. It is a programme between nations to exchanges of data and information at European level.

⇒ **MFS (***Mediterranean Forecasting System).* International project inside GOOS with the objective to give an operational product in the Mediterranean area. Several forecast numerical circulation models have been developed for the western Mediterranean. XBT probes have been furnished as part of the collaboration through the institutes participating at MFS in the frame work of the VOS component (Volunteer Observing Ships) of MFS.

The cruise MedCO08 is also part of the strategy of some CNR institutes in order to analyse hydrological and biogeochemical variabilities as part of the climatic changes. The cruise has been organised in the framework of the following projects:

⇒ **ECOOP - European COastal-shelf sea OPerational observing and forecasting system** (European IP);

⇒ **MyOcean, (**European IP);

⇒ **SESAME - Southern European Seas: Assessing and Modelling Ecosystem changes** (European IP);

⇒ **PRIMI - Progetto Pilota Inquinamento Marino da Idrocarburi**, financing ASI;

⇒ **VECTOR: VulnErabilità delle Coste e degli ecosistemi marini italiani ai cambiamenti climaTici e loro ruolO nei cicli del caRbonio mediterraneo** subproject DIVCOST.